IBM

IBM System Storage DS6000 Series: Copy Services with IBM System z

- Plan, install and configure DS6000 Copy Services with System z
- Learn how to use the management interfaces: TSO, DS CLI, DS GUI
- Learn about TPC for replication support

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Note: Before using this information and the product it supports, read the information in “Notices” on page xv.

Third Edition (December 2006)

This edition applies to features, microcode, GUI and DS CLI as announced for the DS6000 in August 2006.

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Preface

This IBM Redbook will help you plan, install, and configure the IBM System Storage DS6000 Copy Services functions in System z™ environments, and provides the details you need to implement and manage these functions. The book includes hints and tips.

This document is intended to help you either to design and set up a new Copy Services installation, or to migrate from an existing installation. It also addresses functionality and terminology differences from other IBM Copy Services products.

You can read this book in conjunction with the IBM Redbook *IBM System Storage DS6000 Series: Architecture and Implementation*, SG24-6781. You may also wish to refer to the companion IBM Redbook for the DS6000 that supports the configuration of the Copy Services functions in open systems environments, *IBM System Storage DS6000 Series: Copy Services in Open Environments*, SG24-6783.

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Summary of changes

This section describes the technical changes made in this edition of the book and in previous editions. This edition may also include minor corrections and editorial changes that are not identified.

Summary of Changes
for SG24-6782-02
for IBM System Storage DS6000 Series: Copy Services with IBM System z
as created or updated on December 14, 2006.

December 2006, Third Edition

This revision reflects the addition, deletion, or modification of new and changed information described below.

New information

- IBM TotalStorage Productivity Center for Replication
- Data migration through double cascading
- DS6000 model 1750-522

Changed information

- Updated Copy Services examples
- Updated Licensing information

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Part 1

Overview

In Part 1 we describe the various Advanced Copy Services offerings for the IBM System Storage DS6000 series and how they relate to previous Copy Services offerings that are available on the Enterprise Storage Server® (ESS).

This part also shows how the existing Copy Services functions from the ESS can coexist with the Copy Services for the DS6000 series. Similarly, we discuss their use with the DS8000 series Copy Services.

With the announcement of the DS6000 Series and of Advanced Copy Services for z/OS on the DS6000 Series, we have introduced some new terminology. We also introduced these terms for Advanced Copy Services Version 2 for the ESS. These terms are described in detail in *IBM System Storage DS6000 Series: Architecture and Implementation*, SG24-6781, and are summarized in Table 1.

Table 1 Reference chart for DS Copy Services on DS6000.

DS6000 Function	ESS800 Version 2 Function	Formerly known as
FlashCopy®	FlashCopy	FlashCopy
Global Mirror	Global Mirror	Asynchronous PPRC
Metro Mirror	Metro Mirror	Synchronous PPRC
Global Copy	Global Copy	PPRC Extended Distance
z/OS Global Mirror	z/OS Global Mirror	Extended Remote Copy (XRC)
Metro/Global Mirror for System z, 3-site solution as an XRC target only	z/OS Metro/Global Mirror	3-site solution using Sync PPRC and XRC
Metro/Global Copy	Metro/Global Copy	2- or 3-site Asynchronous Cascading PPRC

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You can use either the IBM System Storage DS Storage Command-Line Interface, DS CLI, or the IBM System Storage DS Storage Manager Copy Services Graphical User Interface, DS GUI, to configure Copy Services.

It should be noted that:

- All DS6000 installations require at least an Operating Equipment License (OEL) key to operate. However, Copy Services functions can only be used where the appropriate License Key is installed.
- The key Copy Services license types are: OEL, Remote Mirror and Copy (RMC) or PPRC, and Point-in-Time Copy (PTC) or FlashCopy.
- The DS CLI replaces both the ESS CLI and the ESS Copy Services CLI.
- The DS CLI can also be used for ESS 800 Copy Services, but not ESS configuration. For ESS configuration you must continue to use the ESS Web Specialist or ESS CLI.
- The DS CLI can invoke Remote Mirror relationships with ESS 800, if the ESS 800 is at code level LIC 2.4.3.65 or above.
- The DS CLI can be used in reusable scripts and provides a consistent interface for current and planned System Storage products.
- The DS CLI now invokes a Copy Services function directly rather than invoking a saved task.
- The DS GUI can only be used for one-time execution of a Copy Services operation; it cannot save tasks.

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1

Introduction

This chapter introduces the business drivers for Copy Services and provides a brief summary of the various Copy Services functions available on the DS6000 series. These services are very similar to the existing Copy Services for the IBM Enterprise Storage Server, and some models of the ESS are interoperable with the DS8000 as well as the DS6000

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1.1 Introduction to Copy Services

We briefly describe each function of the Copy Services in this section. Copy Services are a collection of functions that provide for Disaster Recovery, data migration, and data duplication functions. There are two primary types of Copy Services functions: *Point-in-Time Copy* and *Remote Mirror and Copy*. Generally, the Point-in-Time Copy function is used for data duplication and the Remote Mirror and Copy function is used for data migration and Disaster Recovery.

With the Copy Services functions, you can create backup data with little or no disruption to your application, and you can back up your application data to the remote site for uses such as Disaster Recovery.

Copy Services run on the DS6000 Storage Unit and support open systems and System z environments. These functions are also supported on the DS8000 series and the previous generation of storage systems, the IBM TotalStorage Enterprise Storage Server (ESS).

Many design characteristics of the DS6000 and data copying and mirroring capabilities of the Copy Services features contribute to the protection of data, 24 hours a day and seven days a week. The licensed features included in Copy Services are the following:

- FlashCopy, which is a Point-in-Time Copy function
- Remote Mirror and Copy functions, previously known as Peer-to-Peer Remote Copy or PPRC, which include:
  - IBM System Storage Metro Mirror, previously known as synchronous PPRC
  - IBM System Storage Global Copy, previously known as PPRC Extended Distance
  - IBM System Storage Global Mirror, previously known as Asynchronous PPRC
- z/OS Global Mirror, previously known as Extended Remote Copy (XRC)
- z/OS Global Mirror and Metro Mirror across three sites. In this environment the DS6000 can only operate as a secondary system.

We explain these functions in more detail in the next section.

You can manage the Copy Services functions through a command-line interface (DS CLI) and a new Web-based interface (DS Storage Manager). You can also manage the Copy Services functions through the open application programming interface (DS Open API). When you manage the Copy Services through these interfaces, these interfaces invoke Copy Services functions via the Ethernet network. In System z environments, you can invoke the Copy Service functions by TSO commands, ICKDSF, the DFSMSdss™ utility, and so on.

We explain these interfaces in Part 2, “Interfaces” on page 15.

1.1.1 Point-in-Time Copy (FlashCopy)

The Point-in-Time Copy feature, which includes FlashCopy, enables you to create full volume copies of data in a Storage Unit. To use it, you must purchase the Point-in-Time Copy License feature code #5200 PTC for the required DS6800 storage server machine type 1750.

When you set up a FlashCopy operation, a relationship is established between the source and target volumes, and a bitmap of the source volume is created. Once this relationship and bitmap are created, the target volume can be accessed as though all the data had been physically copied. While a relationship between the source and target volume exists, optionally, a background process copies the tracks from the source to the target volume.

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When a FlashCopy operation is invoked, it takes only a few seconds to complete the process of establishing the FlashCopy pair and creating the necessary control bitmaps. Thereafter, you have access to a Point-in-Time Copy of the source volume. As soon as the pair has been established, you can read and write to both the source and target volumes.

After creating the bitmap, a background process begins to copy the real data from the source to the target volumes. If you access the source or the target volumes during the background copy, FlashCopy manages these I/O requests, and facilitates both reading from and writing to both the source and target copies. When all the data has been copied to the target, the FlashCopy relationship is ended.

1.1.2 Remote Mirror and Copy RMC (formerly Peer-to-Peer Remote Copy)

The Remote Mirror and Copy (RMC) license authorization enables several Copy Services functions depending on the configuration and settings you use. RMC is a flexible data mirroring technology that allows replication between volumes on two or more disk storage systems. You can also use this feature for data backup and Disaster Recovery.

Remote Mirror and Copy is an optional function. To use it, you must purchase the Remote Mirror and Copy function authorization code #5300 RMC for the required DS6800 storage server machine type 1750.

DS6000 Storage Units can participate in Remote Mirror and Copy solutions with another DS6000, or with the ESS Model 750, ESS Model 800, and DS8000 Storage Units. To establish an RMC (formerly PPRC) relationship between the DS6000 and the ESS, the ESS needs to have licensed internal code (LIC) Version 2.4.3.65 or later.

The Remote Mirror and Copy feature can operate in the following modes:

Metro Mirror (formerly Synchronous PPRC)

Metro Mirror provides real-time mirroring of logical volumes between two DS6000s that you can place up to 300 km from each other. It is a synchronous copy solution where write operations are completed on both copies (local and remote site) before they are considered to be complete.

Global Copy (formerly PPRC-XD)

Global Copy copies data non-synchronously and over longer distances than is possible with Metro Mirror. When operating in Global Copy mode, the source volume sends a periodic, incremental copy of updated tracks to the target volume, instead of sending a constant stream of updates. This causes less impact to application writes for source volumes and less demand for bandwidth resources, while allowing a more flexible use of available bandwidth.

Global Copy does not keep the sequence of write operations. Therefore, the copy is normally fuzzy, but you can make a consistent copy through synchronization (called a go-to-sync operation). After the synchronization, you can issue FlashCopy at the secondary site to make the backup copy with data consistency. After the establishment of the FlashCopy, you can change the mode back to non-synchronous mode.

Note: When you change from synchronous to non-synchronous mode, you must suspend first, and then change mode to non-synchronous mode.

If you want to make a consistent copy with FlashCopy, you must purchase a Point-in-Time Copy function authorization license for the secondary Storage Unit.

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Global Mirror (Asynchronous PPRC)

Global Mirror provides a long-distance remote copy feature across two sites using asynchronous technology. This solution is based on the existing Global Copy and FlashCopy. With Global Mirror, the data that the host writes to the Storage Unit at the local site is asynchronously shadowed to the Storage Unit at the remote site. A consistent copy of the data is automatically maintained on the Storage Unit at the remote site.

Global Mirror operations provide the benefit of supporting operations over virtually unlimited distances between the local and remote sites, restricted only by the capabilities of the network and the channel extension technology. It can also provide a consistent and restartable copy of the data at the remote site, created with minimal impact to applications at the local site.

The ability to maintain an efficient synchronization of the local and remote sites with support for failover and failback modes helps to reduce the time that is required to switch back to the local site after a planned or unplanned outage.

1.1.3 Optional Copy Services function for z/OS

The following functions are only available for z/OS environments with restrictions for where they can be employed.

z/OS Global Mirror RMZ (formerly XRC)

DS6000 storage servers support z/OS Global Mirror only as a secondary storage server. You cannot use a DS6000 as a primary storage server for z/OS Global Mirror.

The z/OS Global Mirror function mirrors data on the Storage Unit to a remote location for Disaster Recovery. It protects data consistency across all volumes that you have defined for mirroring. The volumes can reside on several different Storage Units. The z/OS Global Mirror function can mirror the volumes over several thousand kilometers from the source site to the target recovery site. With z/OS Global Mirror, you can suspend or resume service during an outage. You do not have to terminate your current data-copy session. You can suspend the session, then restart it. Only data that changed during the outage must be re-synchronized between the copies.

z/OS Global Mirror and Metro Mirror across 3 sites

This mirroring capability uses z/OS Global Mirror to mirror primary site data to a location that is a long distance away and also uses Metro Mirror to mirror primary site data to a location within the metropolitan area. This enables a z/OS 3-site high availability and disaster recovery solution for even greater protection from unplanned outages. To use it, you must purchase both of the following functions:

- Remote Mirror for z/OS (2244 Model RMZ for DS8000 Series) on primary site
- Remote Mirror and Copy function (2244 Model RMC for DS8000 Series or Machine Type 1750 feature code #5300 RMC for the DS6000 Series) for the primary Storage Unit and secondary Storage Units at the alternate metropolitan site

Restriction: The XRC and 3-site z/OS Global Mirror environments are supported on DS6000 Series only as secondary servers at remote sites. They only require standard DS6000 Copy Services licenses for RMC for the appropriate storage level in a CKD environment.

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2

Copy Services architecture

This chapter is an overview of the structure of the Copy Services communication architecture in either an open or System z environment. The chapter covers the following topics:

- Introduction to the Copy Services structure
- How the new structure of Copy Services works
- System z communication path for Copy Services

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2.1 Introduction to the Copy Services structure

The Copy Services architecture for the IBM ESS 800 used a construct called a *Copy Services Domain* to manage Copy Services. The communications architecture for DS6000 and DS8000 is noticeably different. Instead of a Copy Services Domain, we now use the concept of *Storage Complexes*.

You can perform Copy Services operations both within or between Storage Complexes. An ESS 800 Copy Services Domain (at the correct firmware level) can, for management purposes, appear to a DS6000 or DS8000 as an independent Storage Complex.

Now within a Storage Complex you will find management consoles, Storage Units, and in the case of DS8000, Storage Facility Images. First, we define each of these constructs.

2.1.1 What is a management console?

A management console is a PC that is used to manage the devices within a Storage Complex. In the case of the DS6000, it is a PC with a Windows operating system, onto which the user has installed the DS Storage Manager Console software. This is usually referred to as a Storage Management Console or SMC. In the case of the DS8000, it is a dedicated PC that comes with a pre-installed Linux-based operating system and pre-installed management software. The DS8000 console is called a Hardware Management Console (HMC).

In either case, the end-user interacts with the management console using either the Web browser-based DS GUI or the Command-Line Interface (DS CLI). It is possible using the DS GUI to manage Copy Services operations on multiple Storage Complexes.

2.1.2 What is a Storage Unit?

A Storage Unit is the physical storage device (including expansion enclosures) that you see when you walk into the computer room. If you open a rack door and look at a DS6000 system enclosure (a 1750-511 or 522) and all its attached expansion enclosures (1750-EX1 or EX2), then you are looking at a single DS6000 Storage Unit. If you then look at a DS8000 sitting on the floor (with any attached expansion racks), then you are looking at a DS8000 Storage Unit. An example would be a 2107-922 or 932 with an attached 2107-9E2. Another example would be a 2107-9A2 with an attached 2107-9AE. Each example would be a single DS8000 Storage Unit.

2.1.3 What is a Storage Facility Image (SFI)?

The Storage Facility Image construct is different for the DS6000 and DS8000.

DS6000 SFI

For the DS6000, the SFI concept does not really apply. You could say that each DS6000 Storage Unit contains one SFI. However, in general a DS6000 is always referred to as simply a Storage Unit. When using the DS CLI, there are separate commands to display a DS6000 Storage Unit or a DS6000 SFI. However, both will refer to the same device. Using the DS GUI, you only work with the DS6000 Storage Unit. The GUI will not offer an option to select a DS6000 SFI. In Example 2-1 we connect to a DS6000 Management Console using the DS CLI. We issue the `lssu` command to display the DS6000 Storage Unit and the `lssi` command to display the DS6000 Storage Facility Image. In each case we see the same serial number and the same WWNN (World Wide Node name). The Storage Unit and the SFI are the same.

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Example 2-1 Difference between a DS6000 Storage Unit and DS6000 SFI

```
dscli> lssu
Date/Time: 13 November 2005 19:21:17 IBM DSCLI Version: 5.1.0.204
Name     ID               Model WWNN             pw state
=======================================================
13-00247 IBM.1750-1300247 511   500507630EFFFE16 On
dscli> lssi
Date/Time: 13 November 2005 19:21:44 IBM DSCLI Version: 5.1.0.204
Name ID               Storage Unit     Model WWNN             State  ESSNet
==============================================================================
-    IBM.1750-1300247 IBM.1750-1300247 511   500507630EFFFE16 Online Enabled
```

DS8000 SFI

For the DS8000, the SFI concept is necessary because a DS8000 can be ordered as a model 9A2 or 9B2. In these models all resources in the DS8000 are divided between two separate machine images. This means that to all attached hosts, a single DS8000 Storage Unit effectively contains two DS8000s. It is like having two separate machines in one physical box.

This means that when using the DS GUI or the DS CLI, you have to be very clear whether you are working with the SFI or with the Storage Unit. For most operations you always work with an SFI. You can tell the difference very easily. The serial number of the Storage Unit always ends in zero. The serial number of the first SFI always ends in 1. If you have ordered a model 2107-9A2 or 2107-9B2, then you will also have a second SFI. The serial number of the second SFI always ends in 2.

DS8000 Model 921 and 922 SFI example

In Example 2-2, we used the DS CLI to connect to a DS8000 Management Console. We issued the **lssu** command to display the DS8000 Storage Unit of a 2107-922. We then issued the **lssi** command to display the DS8000 Storage Image on that Storage Unit. The Storage Unit serial number is 7520780. The SFI serial number is 7520781. Note how the Storage Unit and the SFI have different WWNNs.

Example 2-2 Difference between a DS8000 Storage Unit and DS8000 SFI - Model 922

```
dscli> lssu
Date/Time: 13 November 2005 19:21:01 IBM DSCLI Version: 5.1.0.204
Name         ID               Model WWNN             pw state
=============================================================
2107-7520780 IBM.2107-7520780 922   5005076303FFF9A5 On
dscli> lssi
Date/Time: 13 November 2005 19:21:21 IBM DSCLI Version: 5.1.0.204
Name      ID               Storage Unit     Model WWNN             State  ESSNet
==============================================================================
ATS_3_EXP IBM.2107-7520781 IBM.2107-7520780 922   5005076303FFC1A5 Online Enabled
```

DS8000 Model 9A2 SFI example

In Example 2-3, we used the DS CLI to connect to a DS8000 Management Console. We issued the **lssu** command to display the DS8000 Storage Unit of a 2107-9A2. We then issued the **lssi** command to display the DS8000 Storage Images for that Storage Unit. The Storage Unit serial number is 7520780. The SFI serial numbers are 7520781 and 7520782. The Storage Unit and the SFIs all have different WWNNs.

Example 2-3 Difference between a DS8000 Storage Unit and DS8000 SFI - Model 9A2

```
dscli> lssu
Date/Time: 13 November 2005 19:25:25 IBM DSCLI Version: 5.1.0.204
Name            ID               Model WWNN             pw state
```


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```
==============================================================
2107_75ABTV1/V2 IBM.2107-75ABTV0 9A2   5005076303FFFE63 On
dscli> lssi
Date/Time: 13 November 2005 19:25:34 IBM DSCLI Version: 5.1.0.204
Name ID               Storage Unit     Model WWNN             State  ESSNet
==============================================================================
-    IBM.2107-75ABTV1 IBM.2107-75ABTV0 9A2   5005076303FFC663 Online Enabled
-    IBM.2107-75ABTV2 IBM.2107-75ABTV0 9A2   5005076303FFCE63 Online Enabled
```

2.1.4 What is a Storage Complex?

A Storage Complex can be one or two DS8000 Storage Units managed by one or two DS HMCs. A Storage Complex could also be one or two DS6000 Storage Units, managed by one or two DS SMCs. In Figure 2-1, you see a logical view of two Storage Complexes, each with one DS6000 Storage Unit. They are running Remote Mirror and Copy. Now, because the two DS SMCs are linked by Ethernet, you could use the DS GUI to connect to either DS SMC and manage Copy Services on both DS6000s.

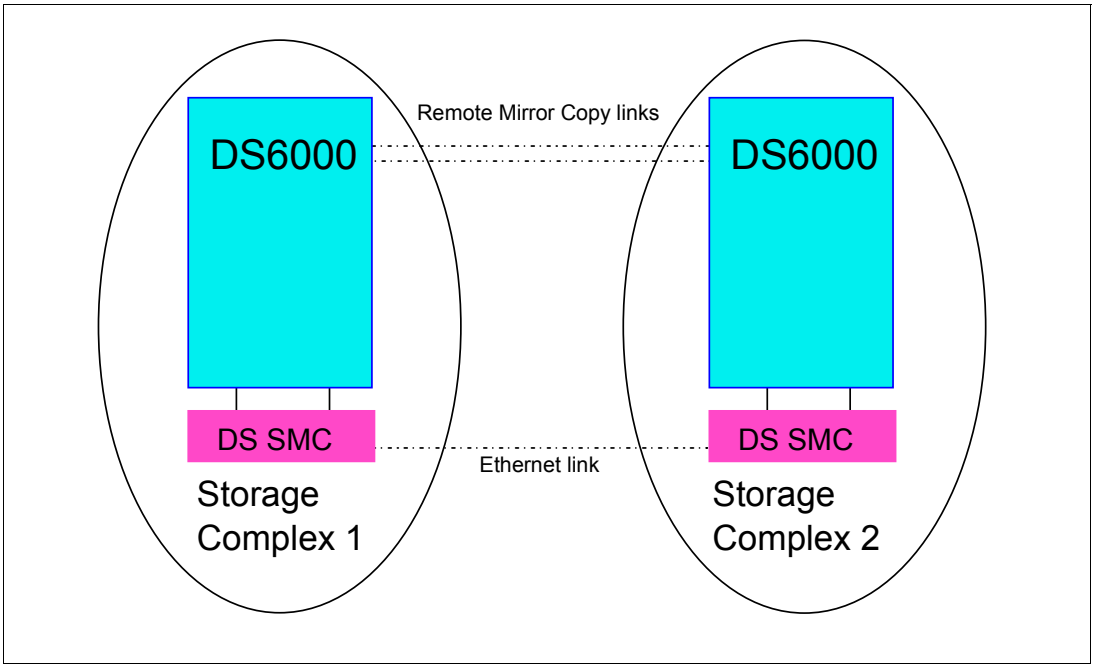

Figure 2-1 Logical view of a Storage Complex

Currently, for the DS8000 and DS6000, you can manage two Storage Units in one Storage Complex. For ESS 800, you can manage up to eight ESS 800s in a single ESS Copy Services domain.

Note: Only servers of the same type, like 2107, can be in the same Storage Complex. However, Storage Complexes with different server types can be joined together. For example, a DS8000 Storage Complex and a DS6000 Storage Complex can be connected.

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2.2 How the new structure of Copy Services works

With the exception of System z commands (see “System z communication path for Copy Services” on page 13), communication to a DS6000 or DS8000 needs an available DS SMC or DS HMC. See Figure 2-2.

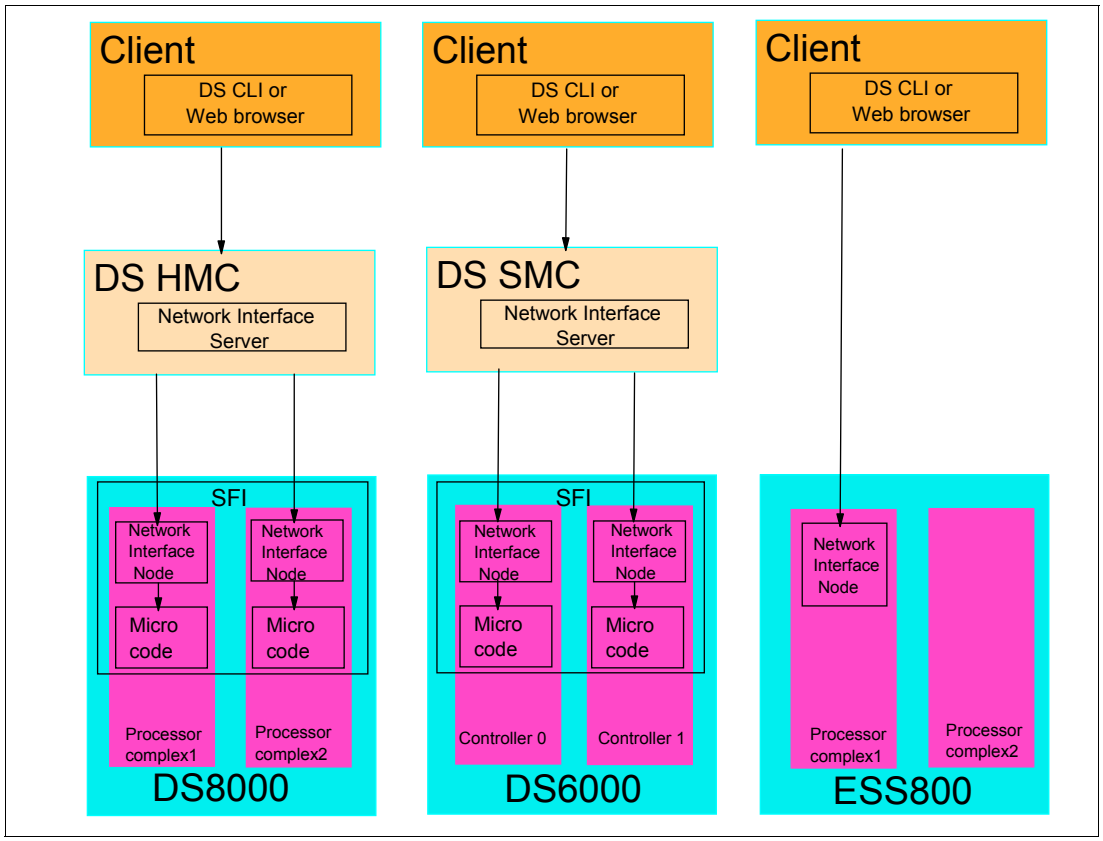

Figure 2-2 Network Interface communication structure

DS8000 management structure

In Figure 2-2, you can see that:

- The client uses either the DS CLI or a Web browser GUI to issue commands to the Network Interface Server running on the DS HMC.
- The Network Interface Server software on the HMC communicates with the Client.
- The Network Interface Server software communicates with the Network Interface Node, which resides on each server of an SFI. From this point, the network interface talks to the microcode, which operates the DS8000.

1750 DS6000 management structure

In Figure 2-2, you can see that:

- The client uses either the DS CLI or a Web browser GUI to issue commands to the Network Interface Server running on the DS SMC.
- The DS Network Interface Server software runs on the DS SMC. This is what the client client communicates with.

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- The Network Interface Server software communicates with the Network Interface Node, which resides on each controller of the DS6000. From this point, the Network Interface then interacts with the microcode that operates the controllers.

2105 ESS 800 management structure

In Figure 2-2 on page 11, you can see that:

- The client uses either DS CLI or a ESS Copy Services Web browser GUI to issue commands to the ESS 800 Copy Services Server running on an ESS 800 cluster. The client could also use the DS GUI to issue commands to the ESS 800 Copy Services Server if a DS6000 SMC or DS8000 HMC is available to route them through (not shown in the diagram).
- The ESS 800 Copy Services Server then interacts with the microcode, which operates the ESS 800.

2.2.1 Remote Mirror and Copy between Storage Complexes

It is possible to use Remote Mirror and Copy between Storage Complexes as depicted in Figure 2-3. In this scenario, there are three Storage Complexes. The complexes are connected at the top of the chart by SAN connections (solid lines) and at the bottom of the chart by an Ethernet LAN (dashed lines).

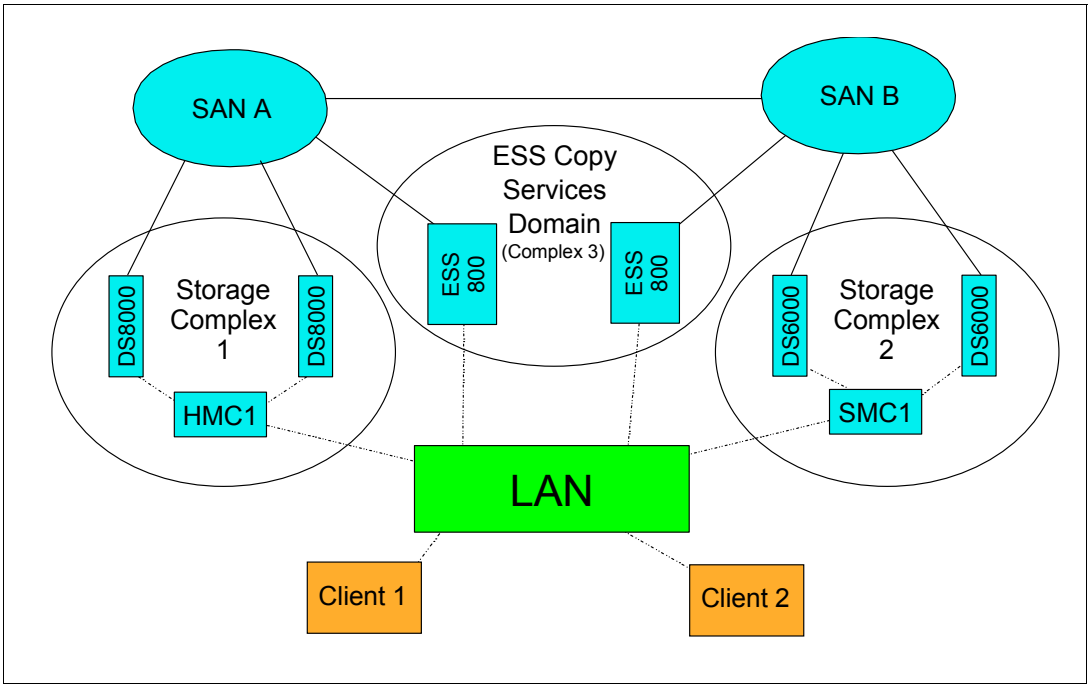

Figure 2-3 Remote Mirror and Copy between Storage Complexes

2.2.2 Differences between the DS CLI and the DS GUI

The DS CLI cannot manage several domains in a single session. However, if a single DS CLI client machine has network access to all Storage Complexes, then that client could issue concurrent DS CLI commands to each complex, each of which would be managed by a separate DS CLI session. The DS CLI can be script driven and scripts can be saved. Therefore, by using DS CLI, you can achieve automation.

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The DS GUI is accessed with a Web browser. The DS GUI cannot save tasks (unlike the ESS, which can), and you cannot use the DS GUI to initiate a series of saved tasks. Instead, you must use the DS CLI. If you wish to use a single GUI to manage multiple Storage Complexes, then, in the GUI, you must define all of the Storage Complexes. This definition allows you to manage FlashCopy or Remote Mirror and Copy on, or between, every Storage Unit in every defined and accessible Storage Complex.

When you look at the structure in Figure 2-2 on page 11, you can see that you need a working DS SMC or DS HMC in every Storage Complex to communicate with the DS6000 or DS8000 for that complex. For an inter-Storage Complex Remote Mirror and Copy, the DS GUI establishes sessions to the source and targets Storage Complexes to show all paths and LUNS. If no DS HMC or DS SMC is available at the remote Storage Complex, you cannot select this Storage Complex as a target.

It is possible to have two SMCs or two HMCs in a Storage Complex for the purpose of redundancy.

2.3 System z communication path for Copy Services

In a z/OS environment, you can issue Copy Services commands to the DS6000 and DS8000 via inband communication. This is done by sending commands via a FICON® (or ESCON® in the case of DS8000) host link to a conduit CKD volume. From there it gets passed to the microcode for execution. This is exactly the same as what is done with an ESS 800. Depending on the operating system, various software packages are available to issue commands; examples include TSO or ICKDSF.

The ability to send inband commands does not necessarily mean that the DS CLI or DS GUI do not have a role to play. To be able to issue a command to a DS6000 or DS8000, a System z operating system needs to be able to communicate with the relevant Storage Unit. We may have a remote Storage Unit that is not connected via FICON (or ESCON in the case of a DS8000) to an active z/OS. This means we would not be able to access a conduit CKD volume on the remote Storage Unit. Now, provided we have TCP/IP connectivity and an appropriate management station (such as a Windows host with a Web browser or DS CLI installed), we could use the DS CLI or the DS GUI to manage the remote Storage Unit. We could then use inband commands to manage the local Storage Unit. If the remote and local Storage Units were connected by RMC links, then we could also send some commands inband via the RMC links, such as commands to establish FlashCopies of the remote RMC target volumes.

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Part 2

Interfaces

In this part we discuss the interfaces available to manage the Copy Services features of the DS6000. We give an overview of the interfaces, discuss the options available, discuss configuration considerations, and give some usage examples of the interfaces.

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3

DS Storage Manager

This chapter is an introduction to the IBM System Storage DS™ Storage Manager, which can be used to configure and administer the DS storage system. The DS Storage Manager is an interface that is used to perform logical configurations, service, Copy Services management, and firmware upgrades.

The topics covered in this chapter are:

- System and hardware requirements
- Installation modes
- Connecting to your DS6000 SMC
- Real-time and simulated configuration
- Accessing the Information Center
- Managing the Storage Complex

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3.1 System and hardware requirements

The DS Storage Manager is a Web-based graphical user interface (GUI) that is used to perform logical configuration and Copy Services management functions. It can be accessed with a Web browser from any location that has network access to the DS management console.

The DS Storage Manager software must be installed on a user-provided computer. We refer to this computer as the DS Storage Management Console (SMC).

Because the DS Storage Manager is required to manage the DS6000, to perform Copy Services operations, or to allow remote service, the DS SMC computer must always be on.

A management console is the configuration, service, and management portal for the DS6000 series. You must have a computer to use as the management console and this computer must meet the following minimum set of hardware and operating system compatibility requirements:

- 1.4 GHz Pentium® 4
- 256 KB cache
- 512 MB memory
- 1 GB disk space for the DS Storage Manager software
- 1 GB work space per managed Integrated RAID Controller (IRC)
- IP Network connectivity to each RAID controller card

It is also useful to have:

- IP network connectivity to an external network to enable remote support
- Serial connectivity to the DS6000

3.1.1 Supported operating systems

The SMC is supported by the following operating systems:

- Microsoft® Windows 2000
- Microsoft Windows 2000 Server
- Microsoft Windows XP Professional
- Microsoft Windows 2003 Server

Note: For the most recent information about currently supported operating systems, refer to the IBM System Storage DS6000 Information Center Web site at:

`http://publib.boulder.ibm.com/infocenter/ds6000ic/index.jsp`

Supported browsers

The currently supported browsers for accessing the DS Storage Manager are:

- Internet Explorer® 6.X
- Netscape 6.2
- Netscape 7.X

3.2 Installation modes

Install the DS Storage Manager using a graphical or silent mode for the Windows operating systems. Access it using a Web browser from any location that has network access.

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You can choose to install DS Storage Manager on the Windows operating system with either of the graphical mode or the unattended mode:

- The graphical mode allows you to use an online wizard that guides you through the installation process providing prompts and information necessary to complete the installation.
- The unattended mode (also called *silent mode*) allows you to customize a response file and issue a command to complete the installation process.

After you have installed the DS6000 Storage Manager, the following results occur:

- The DS Storage Manager server and the IBM System Storage DS Network Interface server are activated. These servers are set to automatic startup, so that when you start your computer, these servers are automatically started as Windows services.
- The DS Storage Manager application, which includes the real-time and simulated manager components, is activated. These components can both be installed on the same server and are integrated into the user interface. They are designed to help you create and manage the physical and logical configurations of your Storage Complexes and Storage Units. Also, the real-time manager application provides you the opportunity to use the Copy Services features that you have purchased.

Note: To see the complete installation process in detail, refer to *IBM System Storage DS6000: Installation, Troubleshooting, and Recovery Guide*, GC26-7924.

3.3 Connecting to your DS6000 SMC

To connect to the DS6000 SMC from the browser, enter the Web site address (URL) of the PC or the DS SMC that you have purchased. The Web site consists of the TCP/IP address as shown in Figure 3-1, or a fully qualified name that the DNS server can resolve.

IBM System Storage™ DS6000 Storage Manager
IBM.
IBM System Storage DS6000 Sign On
The user session has expired. Enter user name and password to sign on.
*User name
*Password
OK
Cancel
Welcome
IBM System Storage
DS6000
If the session is inactive for more than two hours after you log on, the session expires, and you must log on again.

Figure 3-1 Connecting to a DS6000 with a Web browser

If, for example, your SMC IP address is 10.0.0.1 and you connect to *http://10.0.0.1*, you will not get a successful connection. This is because the DS Storage Manager is accessible by connecting to either:

```
http://10.0.0.1:8451/DS6000
https://10.0.0.1:8452/DS6000
```


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Clearly, you should change the IP address to match the one used by your SMC. If you are actually working on the SMC PC itself, you can also use 127.0.0.1 since this is the loopback address that connects to the local PC.

Logging in to the DS Storage Manager requires that you provide your user ID and password. This function is generally administered through your system administrator and by your company policies. The preconfigured user ID and password are as follows:

- User ID: `admin`
- Password: `admin`

When you log on to the SMC for the first time using the *admin* user ID, you must change the password from *admin* to something more secure.

3.3.1 Real-time and simulated configuration

You have the following options to access the DS Storage Manager:

- Simulated (offline) manager

  This application allows you to create or modify logical configurations when disconnected from the network. After creating an initial configuration, you can save it and then apply it to a new or unconfigured Storage Unit at a later time. However, you cannot use the Simulated manager to perform any type of Copy Services configuration. You must perform Copy Services configuration from the Real-time manager.

- Real-time (online) manager

  This provides real-time management support for logical configuration and Copy Services functions to a DS6000 Storage Unit.

3.3.2 Advantages of using the DS GUI over the DS CLI or TSO

The DS Storage Manager GUI has the following advantages for managing Remote Mirror and Copy functions:

- It requires less specialized skills for effective use.
- It is a real-time graphical interface for the DS6000 subsystem, which may present information more easily to some users.
- You do not need to install anything on your PC in order to manage Copy Services: a simple Web browser pointed to the DS SMC is enough.

3.3.3 Disadvantages of using the DS GUI over the DS CLI or TSO

The DS Storage Manager GUI has the following disadvantages for managing Remote Mirror and Copy functions:

- You cannot perform all supported functions from this interface.
- You cannot use this interface for automated actions.
- You cannot save your actions and reuse them later.

You still must understand the implications of the actions you are performing (for example, you need to understand that a FlashCopy overwrites the target LUN or volume).

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3.4 Accessing the Information Center

The Software Information Center provides product or application information and a GUI for browsing and searching online documentation. The broad range of topics covered includes accessibility, Copy Services, device storage, host system attachments, concurrent code loads, input/output configuration programs, and volume storage.

Accessing the Information Center directly

You can connect to the Information Center directly using a Web browser. If your SMC IP address is 10.0.0.1 then you can access the Information Center running on that SMC at:

`http://10.0.0.1:8455`

If you are locally logged onto the SMC then you can also use:

`http://127.0.0.1:8455`

To access the public version of the DS6000 Information Center, go to:

`http://publib.boulder.ibm.com/infocenter/ds6000ic/index.jsp`

Accessing the Information Center using the help symbol

The help panels are accessed by selecting the**?** symbol on the right side of the panel, which is indicated by the arrow in Figure 3-2.

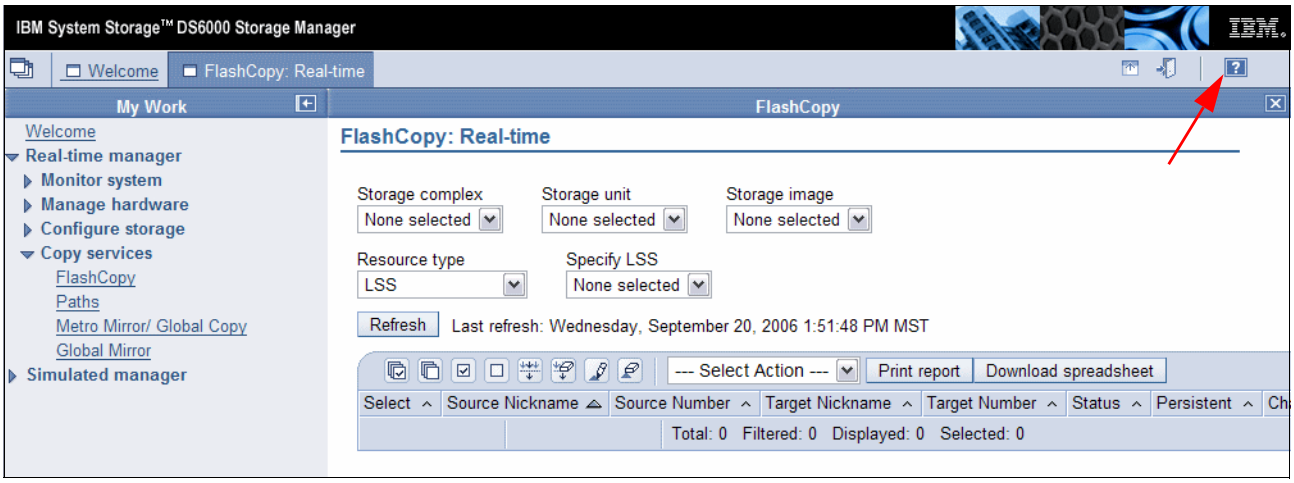

Figure 3-2 Help option location

The help panel opens on the current subject of the configuration panel. In Figure 3-3, the help was called from the FlashCopy main page, so the help for that page opened.

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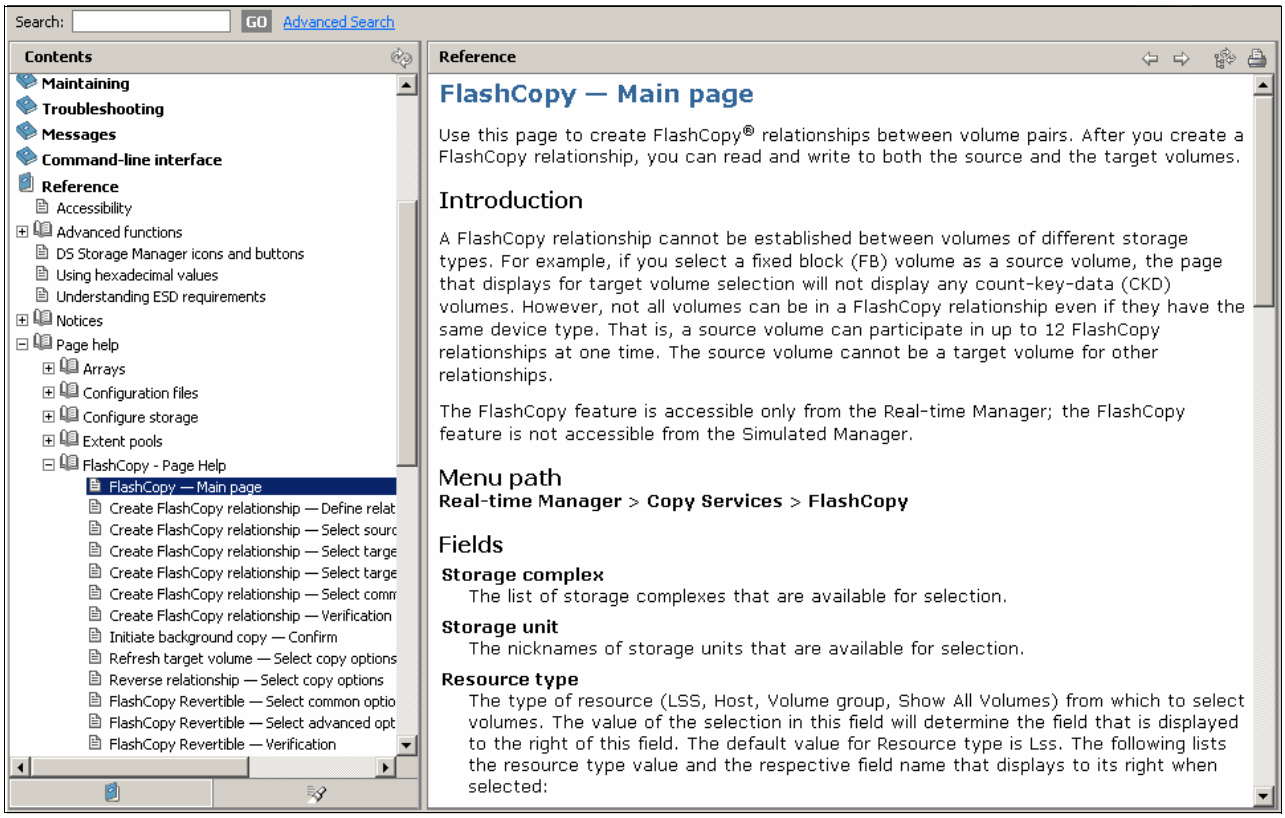
Search:
GO
Advanced Search
Contents
Maintaining
Troubleshooting
Messages
Command-line interface
Reference
Accessibility
Advanced functions
DS Storage Manager icons and buttons
Using hexadecimal values
Understanding ESD requirements
Notices
Page help
Arrays
Configuration files
Configure storage
Extent pools
FlashCopy - Page Help
FlashCopy — Main page
Create FlashCopy relationship — Define relat
Create FlashCopy relationship — Select sourc
Create FlashCopy relationship — Select targe
Create FlashCopy relationship — Select targe
Create FlashCopy relationship — Select comm
Create FlashCopy relationship — Verification
Initiate background copy — Confirm
Refresh target volume — Select copy options
Reverse relationship — Select copy options
FlashCopy Revertible — Select common optio
FlashCopy Revertible — Select advanced opt
FlashCopy Revertible — Verification
Reference
FlashCopy — Main page
Use this page to create FlashCopy® relationships between volume pairs. After you create a FlashCopy relationship, you can read and write to both the source and the target volumes.
Introduction
A FlashCopy relationship cannot be established between volumes of different storage types. For example, if you select a fixed block (FB) volume as a source volume, the page that displays for target volume selection will not display any count-key-data (CKD) volumes. However, not all volumes can be in a FlashCopy relationship even if they have the same device type. That is, a source volume can participate in up to 12 FlashCopy relationships at one time. The source volume cannot be a target volume for other relationships.
The FlashCopy feature is accessible only from the Real-time Manager; the FlashCopy feature is not accessible from the Simulated Manager.
Menu path
Real-time Manager > Copy Services > FlashCopy
Fields
Storage complex
The list of storage complexes that are available for selection.
Storage unit
The nicknames of storage units that are available for selection.
Resource type
The type of resource (LSS, Host, Volume group, Show All Volumes) from which to select volumes. The value of the selection in this field will determine the field that is displayed to the right of this field. The default value for Resource type is Lss. The following lists the resource type value and the respective field name that displays to its right when selected:

Figure 3-3 FlashCopy help Main page

3.5 Managing the Storage Complex

When you install the DS Storage Manager software on a PC, a Storage Complex is automatically created. You can then add up to two DS6000s to the Storage Complex. Each DS6000 is a Storage Unit. Because an SMC can manage two DS6000s, a single Storage Complex could consist of one SMC and two DS6000s. Figure 3-4 shows how we connected to the Storage Complex managed by the SMC at the 10.0.0.1 IP address.

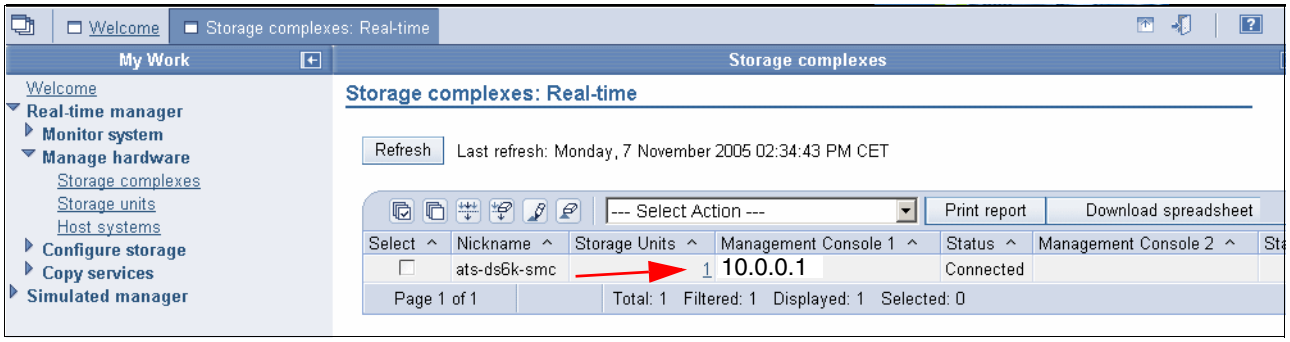

Figure 3-4 A single Storage Complex with a single Storage Unit

This complex consists of one Storage Unit, as indicated by the arrow.

A simple scenario might involve two sites. At the production site, there is a single DS6000 managed by its own SMC. Then, at a remote site a second DS6000 is managed by its own

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SMC. There is Ethernet connectivity between the sites. Because each SMC manages only the DS6000 at its own site, this means there are two Storage Complexes. To use a single GUI to manage Copy Services at either site, then you must add these Storage Complexes to each other. Once you have done this, you can use one SMC to manage Copy Services on either Storage Unit at either site. We can also use one SMC to set up Copy Services relations between the two sites.

3.5.1 Procedure to add a Storage Complex

This section describes the procedure for adding a Storage Complex.

Note: To use either SMC to manage the Storage Units of the other you must do this operation once in each direction, that is, you must add Complex1 to Complex2 and then add Complex2 to Complex1.

Important: Make sure the user ID you use to log on to the DS6000 DS GUI also exists on the other DS6000 SMC and that it has the same password. If not, the operation to add the Storage Complex will fail. You will need to always use this same user ID for multi-complex management.

To add a Storage Complex:

1. Connect to the DS6000 SMC using the DS GUI.
2. Click **Real-time manager**.
3. Click **Manage hardware**.
4. Click **Storage complexes**.
5. Select **Add Storage Complex** and click **Go**.

   Figure 3-5 on page 23 shows the Add Storage Complex panel.

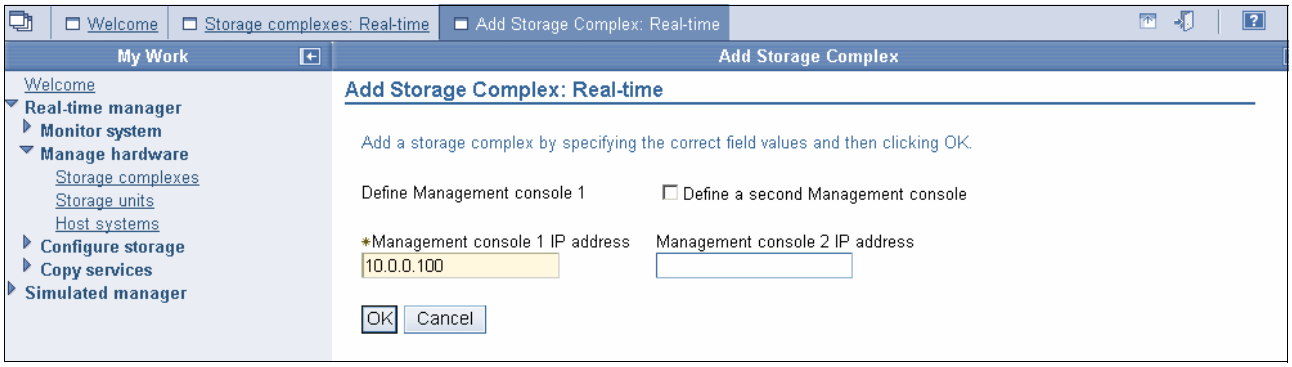

Figure 3-5 Add Storage Complex panel

6. Type the IP address of the SMC for the other Storage Complex in the *Management console 1 IP address* field. If the other Storage Complex has a second SMC, select **Define a second Management console** box and type the second SMC address into the *Management console 2 IP address box*. Click **OK**.
7. After the add Storage Complex operation is complete, the Storage Complex panel shows the DS6000 SMC as an additional Storage Complex. In Figure 3-6, you can see the successful addition of a second Storage Complex that manages two Storage Units.

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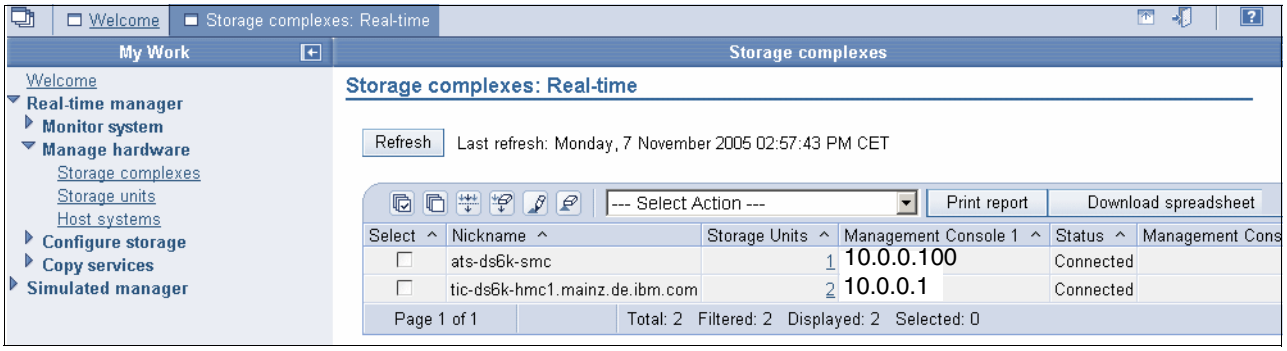

Figure 3-6 Successful addition of a Storage Complex

8. Having added one DS6000 Storage Complex to another, you can use the DS6000 DS GUI to create paths and Remote Mirror and Copy pairs between any of the Storage Units. You can also use the DS6000 DS GUI to manage FlashCopy pairs on any DS6000. This is all assuming the relevant licenses are present.

Note: The steps to add one DS6000 Storage Complex to another DS6000 Storage Complex cannot be performed with the DS CLI.

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4

DS Command-Line Interface

This chapter provides an introduction to the DS Command-Line Interface (DS CLI), which can be used to configure and administer the DS6000 storage systems. It describes how it can be used to manage Copy Services relationships.

In this chapter we describe:

- System requirements
- Command modes
- List of the commands
- User assistance
- Return codes

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4.1 Introduction and functionality

The IBM System Storage DS Command-Line Interface (DS CLI) enables open systems hosts to invoke and manage FlashCopy and Remote Mirror and Copy functions through batch processes and scripts.

While there is no support for z/OS as a server for the DS CLI, you can use the DS CLI from a supported server to control and manage Copy Services functions on z/OS volumes.

Note: Most z/OS environments choose to use one of the z/OS interfaces to manage their volumes. You may choose to use the DS CLI, if you are also managing open systems volumes and want to use a single interface. However, with recent changes to TSO commands to enable control of open systems Copy Services functions, you may choose to use the TSO commands to manage both z/OS and open systems volumes.

The DS CLI provides a full-function command set that you can use to check your Storage Unit configuration and perform specific application functions when necessary.

Before you can use the DS CLI commands, you must ensure the following:

- The DS SMC must have been installed as a Full Management Console installation management type.
- You must configure your Storage Unit (part of the DS Storage Manager post-installation instructions).
- You must activate your license activation codes before you can use the DS CLI commands associated with Copy Services functions.

The following list highlights a few of the specific types of functions that you can perform with the DS CLI:

- Create user IDs that can be used with the GUI and the DS CLI.
- Manage user ID passwords.
- Install activation keys for licensed features.
- Manage Storage Complexes and Units.
- Configure and manage Storage Facility Images.
- Create and delete RAID arrays, Ranks, and Extent Pools.
- Create and delete logical volumes.
- Manage host access to volumes.
- Check the current Copy Services configuration that is used by the Storage Unit.
- Create, modify, or delete Copy Services configuration settings.

4.2 Supported operating systems for the DS CLI

The DS CLI can be installed on these operating systems:

- IBM AIX 5.1, 5.2, 5.3
- HP-UX 11.0, 11i v1, v2
- HP-True64 5.1, 5.1A
- Linux (RedHat 3.0 Advanced Server (AS) and Enterprise Server (ES))
- SUSE Linux SLES 8, SLES 9, SUSE 8, SUSE 9
- System i system i5/OS 5.3
- Novell NetWare 6.5
- Sun™ Solaris 7, 8, 9
- Windows 2000, Windows Datacenter, Windows 2003, Windows XP

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Note: The DS CLI cannot be installed on a Windows 64-bit operating system.

Important: For the most recent information about currently supported operating systems, refer to the IBM System Storage DS6000 Information Center Web site at:

`http://publib.boulder.ibm.com/infocenter/ds6000ic/index.jsp`

The DS CLI is supplied and installed via a CD that ships with the machine. The installation does not require a reboot of the open systems host. The DS CLI requires Java™ 1.4.1 or higher. Java 1.4.2 for Windows, AIX, and Linux is supplied on the CD. Many hosts may already have a suitable level of Java installed. The installation program checks for this requirement during the installation process and does not install DS CLI, if you do not have the correct version of Java.

The installation process can be performed via a shell, such as the bash or Korn shell, or the Windows command prompt, or via a GUI interface. If performed via a shell, it can be performed silently using a profile file. The installation process also installs software that allows the DS CLI to be completely de-installed should it no longer be required.

If you need any assistance to install the DS CLI, refer to *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922.

4.3 User accounts

The administrator account is set up automatically at the time of installation. It is accessed with the `admin` user ID and the default `admin` password. This password is temporary; you must change the password before you can use any of the other functions. There are seven groups the administrator can assign to a user. The groups and the associated functions allowed by the assignment are as follows:

- admin: Allows access to all storage management console server service methods and all Storage Image resources
- op_volume: Allows access to service methods and resources that relate to logical volumes, Hosts, Host Ports, logical subsystems, and Volume Groups, excluding security methods
- op_storage: Allows access to physical configuration service methods and resources, including Storage Complex, Storage Image, Rank, Array, and Extent Pool objects
- op_copy_services: Allows access to all Copy Services service methods and resources, excluding security methods
- service: Monitors authority and access to all management console server service methods and resources, such as performing code loads and retrieving problem logs
- monitor: Allows access to **`list`** and **`show`** commands. It provides access to all read-only, non-security management console server service methods and resources
- no access: Does not allow access to any service method or Storage Image resources. By default, this user group is associated to any user account in the security repository that is not associated with any other user group

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Note: A user can be assigned to more than one user group.

Important: When a new user is created, the password that was initially set automatically expired and must be changed when the user first logs on.

4.4 DS CLI profile

You can create default settings for the DS CLI by defining one or more profiles on the system. For example, you can specify the SMC for the session, specify the output format for list commands, specify the number of rows per page in the DS CLI output, and specify that a banner is included with the DS CLI output.

If a user enters a value with a command that is different from a value in the profile, the command overrides the profile.

You have several options for using profile files:

- You can modify the default profile. The default profile, dscli.profile, is installed in the profile directory with the software. For example, c:\Program Files\IBM\DSCLI\profile\dscli.profile for the Windows platform and /opt/ibm/dscli/profile/dscli.profile for UNIX® and Linux platforms.
- You can make a personal default profile by making a copy of the system default profile as <user_home>/dscli/profile/dscli.profile. The home directory, <user_home> is designated as follows:
  - Windows system: C:\Documents and settings\<user_name>
  - UNIX/Linux system: /home/<user_name>
- You can create a profile for the Storage Unit operations. Save the profile in the user profile directory. Two examples are:
  - c:\Program Files\IBM\DSCLI\profile\operation_name1
  - c:\Program Files\IBM\DSCLI\profile\operation_name2

Attention: The default profile file that is created when you install the DS CLI might be replaced every time that you install a new version of the DS CLI. It is a better practice to open the default profile and then save it as a new file. You can then create multiple profiles and reference the relevant profile file with the **`-cfg`** parameter.

These profile files can be specified using the DS CLI command parameter **`-cfg <profile_name>`**. If the -cfg file is not specified, the user's default profile is used. If a user's profile does not exist, the system default profile is used.

Note: A password file, generated using the **`managepwfile`** command is located at the following directory: <user_home>/dscli/security/security.dat.

When you install the command-line interface software, the default profile is installed in the profile directory with the software. The file name is dscli.profile; for example. c:\Program Files\IBM\DSCLI\profile\dscli.profile.

The available variables, detailed descriptions, and information about how to handle them can be found in *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922.

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4.5 Command structure

This is a description of the components and structure of a Command-Line Interface command.

A Command-Line Interface command consists of one to four types of components, arranged in the following order:

1. The command name: Specifies the task that the Command-Line Interface is to perform.
2. Flags: Modify the command. They provide additional information that directs the Command-Line Interface to perform the command task in a specific way.
3. Flags parameter: Provides information that is required to implement the command modification that is specified by a flag.
4. Command parameters: Provides basic information that is necessary to perform the command task. When a command parameter is required, it is always the last component of the command, and it is not preceded by a flag.

4.6 Copy Services commands

We can classify the commands available with the DS CLI as follows:

1. **`ls`** commands: Give you brief information about the copy services state. See Table 4-1.
2. **`show`** commands: Give you detailed information about the copy services state. See Table 4-2.
3. **`mk`** commands: Used to create relationships. See Table 4-3.
4. **`rm`** commands: Used to remove relationships. See Table 4-4.
5. options commands: Used to modify some options in relationships, that were previously created. See Table 4-5 on page 30.

Table 4-1 List commands

Command	Description
lsflash	Lists of FlashCopy relationships
lsremoteflash	Lists of Remote FlashCopy relationships (inband)
lspprc	Lists of Remote Mirror and Copy volumes relationships
lspprcpath	Lists of existing Remote Mirror and Copy path definition
lsavailpprcport	Lists available ports that can be defined as Remote Mirror and Copy
lssession	Displays a list of Global Mirror sessions for a LSS

Table 4-2 List detailed commands

Command	Description
showgmir	Displays detailed properties and performance metrics for Global Mirror
showgmircg	Displays Consistency Group status for a Global Mirror session
showgmiroos	Displays the number of unsynchronized (out of sync) tracks for a Global Mirror session

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Table 4-3 Creation commands

Command	Description
mkflash	Initiates a point-in-time copy from a source to a target volume
mkremoteflash	Initiates a remote copy through a Remote Mirror and Copy relationship
mkgmir	Starts Global Mirror for a session
mkpprc	Establishes a Remote Mirror and Copy relationship
mkpprcpath	Establishes or replaces a Remote Mirror and Copy path over a Fibre Channel
mkesconpprcpath	Creates a Remote Mirror and Copy path over an ESCON connection
mksession	Opens a Global Mirror for a session

Table 4-4 Deletion commands

Command	Description
rmflash	Removes a relationship between FlashCopy pairs
rmremoteflash	Removes a relationship between remote FlashCopy pairs
rmgmir	Removes Global Mirror for the specified session
rmpprc	Removes a Remote Mirror and Copy relationship
rmpprcpath	Removes a Remote Mirror and Copy path
rmsession	Closes an existing Global Mirror session

Table 4-5 Options commands

Command	Description
commitflash	Commits data to a target volume to form a consistency between the source and target
resyncflash	Incremental FlashCopy process
reverseflash	Reverse the direction of a FlashCopy pair
revertflash	Overwrites new data with data saved at the last consistency formation
setflashrevertible	Modifies a remote FlashCopy pair that is part of a Global Mirror to revertible
commitremoteflash	Commit data to a target volume to form a consistency (inband)
resyncremoteflash	Incremental FlashCopy process (inband)
revertremoteflash	Overwrites new data with data saved at the last consistency formation (inband)
setremoteflashrevertible	Modifies a remote FlashCopy pair that is part of a Global Mirror to revertible (inband)
unfreezeflash	Resets a FlashCopy Consistency Group
failoverpprc	Changes a secondary device into a primary suspended and keep the primary in current
failbackpprc	Usually used after a failoverpprc to reverse the direction of the synchronization
freezepprc	Creates a new Remote Mirror and Copy Consistency Group
pausepprc	Pauses an existing Remote Mirror and Copy volume pair relationship
resumepprc	Resumes a Remote Mirror and Copy relationship for a volume pair

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Command	Description
unfreezepprc	Thaws an existing Remote Mirror and Copy Consistency Group
pausegmir	Pauses a Global Mirror processing for a session
resumegmir	Resumes a Global Mirror processing for a session
chsession	Allows to modify a Global Mirror session

Important:

- The Remote Mirror and Copy commands are asynchronous. This means that the command is issued to the DS CLI server and if it is accepted successfully, you receive a successful completion code; however, background activity may still be occurring. For example, a Metro Mirror pair will take some time to establish, as the tracks need to be copied across from the primary to the secondary device. In this example, you should check the state of the volumes using the **lspprc** command until the pairs have reached the Duplex state.
- The **mkflash** and **mkpprc** commands offer the **-wait** flag, which delays command response until copy complete status is achieved. You may choose to use this flag, if you want to be sure of successful completion.

4.7 Using the DS CLI application

You have to log into the DS CLI application to use the command modes. There are three command modes for DS CLI:

- Single-shot mode
- Interactive mode
- Script mode

4.7.1 Single-shot mode

Use the DS CLI single-shot command mode if you want to issue an occasional command, but do not want to keep a history of the commands that you have issued.

You must supply the login information and the command that you want to process at the same time. Use the following example for the single-shot mode:

1. Enter `dscli -HMC1 <hostname or ip address> -user <user name> -passwd <pwd> <command>`
2. Wait for the command to process and display the results.

Example 4-1 shows the use of the single-shot command mode.

Example 4-1 Single-shot command mode

```
C:\Program Files\ibm\dscli>dscli -HMC1 10.10.10.1 -user admin -passwd adminpwd
lsuser
Date/Time: 24 de Maio de 2005 14h38min20s BRT IBM DSCLI Version: X.X.X.X
Name     Group State
=====================
admin    admin locked
admin    admin active
exit status of dscli = 0
```


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Note: When logging in to the DS CLI, you can use the hostname or the IP address of the DS SMC.

4.7.2 Script command mode

Use the DS CLI script command mode, if you want to use a sequence of DS CLI commands. Administrators can use this mode to create automated processes, for example, establishing Remote Mirror and Copy relationships for volume pairs.

You can issue the DS CLI script from the command prompt at the same time that you provide your login information:

1. Enter `dscli -HMC1 <hostname or ip address> -user <user name> -passwd <pwd> -script <full path of script file>`
2. Wait for the script to process and provide a report regarding the success or failure of the process.

Example 4-2 shows the use of the script command mode.

Example 4-2 Script command mode

```
C:\Program Files\ibm\dscli>dscli -HMC1 10.10.10.1 -user admin -passwd adminpwd
 -script c:\test.cli
Date/Time: 24 de Maio de 2005 14h40min22s BRT IBM DSCLI Version: X.X.X.X DS: IBM
IBM.1750-1367890
ID    WWPN             State  Type             topo     portgrp
===============================================================
I0000 500507630E01FC00 Online Fibre Channel-LW SCSI-FCP 0
I0001 500507630E03FC00 Online Fibre Channel-LW -        0
I0002 500507630E05FC00 Online Fibre Channel-LW SCSI-FCP 0
I0003 500507630E07FC00 Online Fibre Channel-LW -        0
I0100 500507630E81FC00 Online Fibre Channel-LW SCSI-FCP 0
I0101 500507630E83FC00 Online Fibre Channel-LW -        0
I0102 500507630E85FC00 Online Fibre Channel-LW SCSI-FCP 0
I0103 500507630E87FC00 Online Fibre Channel-LW -        0
Date/Time: 24 de Maio de 2005 14h40min36s BRT IBM DSCLI Version: X.X.X.X
Name ID               Storage Unit     Model WWNN             State  ESSNet
==========================================================================
-    IBM.1750-1312345 IBM.1750-1312345 511   5005076300FFFC6F Online Enabled
exit status of dscli = 0
```

Attention: The DS CLI script can contain only DS CLI commands. Using shell commands results in process failure. You can add comments to the scripts prefixed by the number sign (#).

When logging in to the DS CLI, you can use the host name or the IP address of the DS SMC.

4.7.3 Interactive mode

Use the DS CLI interactive command mode when you have multiple transactions to process that cannot be incorporated into a script. The interactive command mode provides a history function that makes repeating or checking prior command usage easy to do.

1. Log on to the DS CLI application at the directory where it is installed.

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2. Provide the information that is requested by the information prompts. The information prompts might not appear, if you have provided this information in your profile file. The command prompt switches to a **dscli** command prompt.
3. Begin using the DS CLI commands and parameters. You are not required to begin each command with **dscli**, because this prefix is provided by the **dscli** command prompt.

Example 4-3 shows the use of interactive command mode.

Example 4-3 Interactive command mode

```
C:\Program Files\ibm\dscli>dscli
Enter your username: admin
Enter your password:
Date/Time: 24 de Maio de 2005 14h42min17s BRT IBM DSCLI Version: X.X.X.X  DS:
IBM.1750-1312345
.
dscli> lsarraysite
Date/Time: 24 de Maio de 2005 15h8min57s BRT IBM DSCLI Version: X.X.X.X DS: IBM.
1750-1312345
arsite DA Pair dkcap (Decimal GB) State    Array
=============================================
S1     0                    146.0 Assigned A0
S2     0                    146.0 Assigned A0
S3     0                    146.0 Assigned A1
S4     0                    146.0 Assigned A1
.
dscli> lssi
Date/Time: 24 de Maio de 2005 14h42min59s BRT IBM DSCLI Version: X.X.X.X
Name ID               Storage Unit     Model WWNN             State  ESSNet
==========================================================================
-    IBM.1750-1312345 IBM.1750-1312345 511   500507630EFFFC6F Online Enabled
dscli> quit

exit status of dscli = 0
```

Note: When logging in to the DS CLI, you can use the host name or the IP address of the DS SMC.

4.8 Return codes

When the DS CLI is exited, the exit status code is provided. This is effectively a return code. If DS CLI commands are issued as separate commands (rather than using script mode), then a return code will be presented for every command. If a DS CLI command fails (for instance due to a syntax error or the use of an incorrect password), then a failure reason and a return code will be presented. Standard techniques to collect and analyze return codes can be used.

The return codes used by the DS CLI are shown in Table 4-6.

Table 4-6 Return code table

Return code	Category	Description
0	Success	The command was successful.
2	Syntax error	There is a syntax error in the command.
3	Connection error	There was a connection problem to the server.

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Return code	Category	Description
4	Server error	The DS CLI server had an error.
5	Authentication error	Password or user ID details are incorrect.
6	Application error	The DS CLI application had an error.

4.9 User assistance

The DS CLI is designed to include several forms of user assistance. The main form of user assistance is accessed from the **help** command, such as:

- **help**

  Lists all available DS CLI commands.

- **help -s**

  Lists all DS CLI commands with a brief description of each.

- **help -l**

  Lists all DS CLI commands with syntax information.

If you are interested in more details about a specific DS CLI command, you can use **-l** (long) or **-s** (short) against a specific command. In Example 4-4, the **-s** parameter is used to obtain a short description of the purpose of the **mkflash** command.

Example 4-4 Use of the help -s command

```
dscli> help -s mkflash
mkflash The mkflash command initiates a point-in-time copy from source volumes to target
volumes.
```

In Example 4-5, the **-l** parameter is used to obtain a list of all parameters that can be used with the **mkflash** command.

Example 4-5 Use of the help -l command

```
dscli> help -l mkflash
mkflash [ { -help|-h|-? } ] [-dev storage_image_ID] [-tgtpprc] [-tgtoffline] [-t
gtinhibit] [-freeze] [-record] [-persist] [-nocp] [-wait] [-seqnum Flash_Sequenc
e_Num] SourceVolumeID:TargetVolumeID ... | -
```

Man pages

A *man page* is available for every DS CLI command. Man pages are most commonly seen in UNIX-based operating systems to give information about command capabilities. This information can be displayed by issuing the relevant command followed by **-h**, **-help**, or **-?**, for example:

dscli> **mkflash -help**

or

dscli> **help mkflash**

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4.10 Usage examples

It is not the intent of this section to list every DS CLI command and its syntax. If you need a list of all the available commands or assistance with DS CLI commands, refer to *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922, or you can use the online help.

Example 4-6 shows some of the common commands used on a DS6000.

Example 4-6 Examples of DS CLI commands

```
# The following command establishes flashcopy pairs
dscli> mkflash -dev IBM.1750-1300861 0100-0102:0300-0302
Date/Time: April 25, 2005 5:59:56 PM IST IBM DSCLI Version: 0.0.0.0 DS: IBM.1750-1300861
CMUC00137I mkflash: FlashCopy pair 0100:0300 successfully created.
CMUC00137I mkflash: FlashCopy pair 0101:0301 successfully created.
CMUC00137I mkflash: FlashCopy pair 0102:0302 successfully created.

# The following command establishes Remote Mirror and copy paths
dscli> mkpprcpath -dev IBM.1750-1300861 -remotedev IBM.1750-1300861 -remotewwnn
5005076303FFC03D -srclss 00 -tgtlss 02 I0030:I0031 I0100:I0101
Date/Time: 18:33:22 IST April 25, 2005 IBM DSCLI Version: 0.0.0.0 DS: IBM.1750-1300861
CMUC00149I mkpprcpath: Remote Mirror and Copy path 00:02 successfully established.

# The following command establishes Remote Mirror and copy pairs
dscli> mkpprc -dev IBM.1750-1300861 -remotedev IBM.1750-1300866 -type gcp 0006:0206
Date/Time: 18:43:31 IST April 25, 2005 IBM DSCLI Version: 0.0.0.0 DS: IBM.1750-1300861
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0006:0206 successfully
created.
```


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5

System z interfaces

This chapter discusses the interfaces that are available with the System z servers for managing DS6000 Copy Services functions.

This chapter covers the following topics:

- System z interfaces
- TSO
- ICKDSF
- DFSMSdss
- The ANTRQST macro
- z/TPF commands

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5.1 System z interfaces

In addition to using the DS GUI or the DS CLI, several possible interfaces are available to System z users for managing DS6000 Copy Services relationships. These are:

- TSO
- ICKDSF
- DFSMSdss
- The ANTRQST macro
- Native TPF commands (for z/TPF only)

These interfaces have the advantage of not having to issue their commands to the DS6000 SMC. They can instead directly send commands inband over a FICON channel connection between the DS6000 and the System z operating system. Sending inband commands allows for a very quick command transfer that does not depend on any additional software stacks.

5.1.1 Operating system alternatives

From an operating system point of view, the alternatives to the DS GUI and DS CLI break out as follows:

- z/OS
  - TSO commands
  - ICKDSF
  - DFSMSdss
  - ANTRQST application programming interface (API)
- z/VM®:
  - ICKDSF
- z/VSE™
  - ICKDSF
- z/TPF
  - ICKDSF
  - z/TPF itself

5.2 TSO

TSO commands are commonly used in z/OS environments to manage all kinds of operations. TSO commands can be generated by REXX or CLIST procedures. They can also be generated from other software tools.

You can issue the TSO commands from procedures that are similar to the scripting approach in open systems environments.

Note that TSO requires a z/OS system at the recovery site when you recover a z/OS Global Mirror environment at the remote site.

For a detailed description of TSO commands for managing Copy Services, refer to *z/OS DFSMS Advanced Copy Services,* SC35-0428.

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5.3 ICKDSF

The System z ICKDSF utility offers a means of control for Copy Services functions. ICKDSF is the only direct interface for z/VM and z/VSE environments.

ICKDSF typically runs as a batch program and can be automatically run from batch scheduling products (for example Tivoli® Workload Scheduler).

More information on ICKDSF can be found in *Device Support Facilities User's Guide and Reference*, GC35-0033.

5.4 DFSMSdss

The DFSMSdss commands can be used to manage Copy Services relationships. Detailed information can be found in *z/OS DFSMSdss Storage Administration Reference* SC35-0424.

5.5 The ANTRQST macro

The ANTRQST macro provides an application program call to the application programming interface (API) of the z/OS system data mover (SDM). This macro allows you to call Metro Mirror, z/OS Global Mirror, and FlashCopy functions.

For detailed information, see the IBM publication *z/OS DFSMS Advanced Copy Services*, SC35-0428.

5.6 z/TPF commands

It is also possible to use native z/TPF commands to issue Copy Services commands. An example is the use of the ZXCPY command to initiate a FlashCopy on a z/TPF device.

Information about using z/TPF to control Copy Services can be found at the following Web Information Center at:

`http://publib.boulder.ibm.com/infocenter/tpfhelp/current/index.jsp`

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Part 3

FlashCopy

This part of the book describes the IBM System Storage FlashCopy for DS6000 when used in a System z environment. We discuss the features of FlashCopy and describe the options for its setup. We also show which management interfaces can be used, as well as the important aspects to be considered when establishing FlashCopy relationships.

This part ends with examples showing how FlashCopy is used in the daily business to support the various environments where immediate copies of production data is a requirement.

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6

FlashCopy overview

FlashCopy creates a copy of a volume at a specific point-in-time, which we also refer to as a Point-in-Time copy, instantaneous copy, or time-zero copy (t0 copy).

This chapter explains the basic characteristics of FlashCopy when used in a System z environment with the DS6000. The following topics are discussed:

- FlashCopy operational areas.
- FlashCopy basic concepts.
- FlashCopy in combination with other Copy Services.
- Data set level FlashCopy.

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6.1 Operational environments

It takes only a few seconds to establish the FlashCopy relationships for tens to hundreds or more volume pairs. The copy is then immediately available for both read and write access. In a 24x7 environment, the quickness of the FlashCopy operation allows us to use FlashCopy in very large environments and to take multiple FlashCopies of the same volume for use with different applications. Some of the different uses of FlashCopy are shown in Figure 6-1.

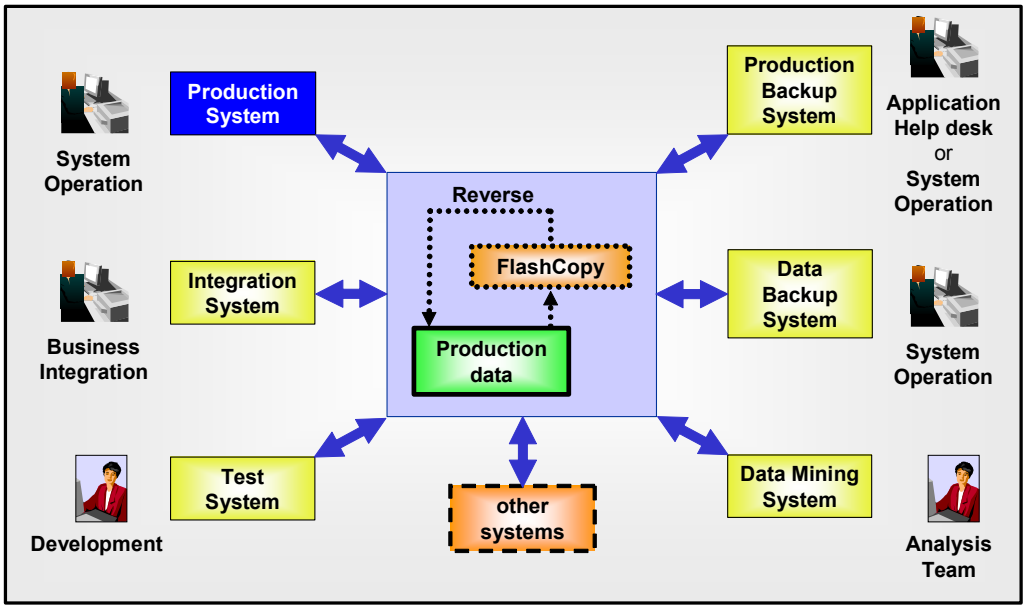

Figure 6-1 FlashCopy uses

FlashCopy is suitable for the following operational environments:

- **Production backup system**
  A FlashCopy of the production data allows data recovery from an older level of data. This might be necessary due to a user error or a logical application error. Let's assume that a user deleted accidentally a customer record. The production backup system could work with a FlashCopy of the data. The necessary part of the customer data can be exported and then be imported into the production environment. Thus, the production continues, and while a specific problem is being fixed, the majority of the users can work with the application without recognizing any problems.

  The FlashCopy of the data could also be used by system operations to re-establish production in case of any server errors.

- **Data backup system**
  A FlashCopy of the production data allows the client to create backups with the shortest possible application outage. The main reason for data backup is to provide protection in case of source data loss due to disaster, hardware failure, software failure, or user errors.

- **Data mining system**
  A FlashCopy of the data can be used for data analysis, thus avoiding performance impacts for the production system due to long running data mining tasks.

- **Test system**
  Test environments created by FlashCopy can be used by the development team to test new application functions with real production data, thus speeding up the test setup process.

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- **Integration system**
  New application releases (for example, SAP® releases) are likely to be tested prior to putting them onto a production server. By using FlashCopy, a copy of the production data can be established and used for integration tests.

With the capability to reverse a FlashCopy, a previously created FlashCopy can be used within seconds to bring production back to the level of data it had at the time when the FlashCopy was taken.

6.2 Terminology

When discussing Metro Mirror, Global Copy and Global Mirror, the following terms are frequently used and interchangeable:

- The terms *local*, *production*, *application*, *primary*, and *source*, denote the site where the production applications run while in normal operation. These applications create, modify, and read the data—the application data. The meaning is extended to the disk subsystem that holds the data as well as to its components—volumes and LSS.
- The terms *remote*, *recovery*, *backup*, *secondary*, and *target*, denote the site to where the data is replicated—the copy of the application data. The meaning is extended to the disk subsystem that holds the data as well as to its components—volumes and LSSs.

When discussing FlashCopy we use the term *source* to refer to the original data that is created by the application. We use the term *target* to refer to the point-in-time backup copy.

Also, the terms LUN and *volume* are used interchangeably in our discussions.

6.3 Basic concepts

In a System z environment, FlashCopy can be used at volume level and at data set level.

Note: Whenever *source* or *target* is used in this chapter without further specification, it refers to both a volume or a data set.

By doing a FlashCopy, a relationship is *established* between a source and a target. Both are considered to form a FlashCopy *pair*.

As result of the FlashCopy either all physical blocks from the source volume are copied (full copy) or—when using the *nocopy* option—only those parts that are changing in the source data since the FlashCopy was established. Currently, the target volume needs to be the same size or bigger than the source volume whenever FlashCopy is used to flash a whole volume.

Typically, large applications such as databases have their data spread across several volumes; their volumes should all be FlashCopied at exactly the same point-in-time. FlashCopy offers consistency groups, which allows multiple volumes to be FlashCopied at exactly the same instance.

The following are basic characteristics of FlashCopy operation:

- **Establish FlashCopy relationship**
  When the FlashCopy is started, the relationship between source and target is established within seconds. This is done by creating the necessary metadata such as a pointer table, including a bitmap for the target.

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While the FlashCopy relationship is being created, the DS6000 holds off the I/O activity to the volume for an interval of time by putting the source volume in an *extended long busy* condition. No user intervention is required. I/O activity resumes when the FlashCopy *establish* process is completed.

If all bits for the bitmap representing the target are set to their initial values, this means that no data block has been copied so far. The data in the target is not modified during setup of the bitmaps. At this very first step the bitmap and the data look as illustrated in Figure 6-2.

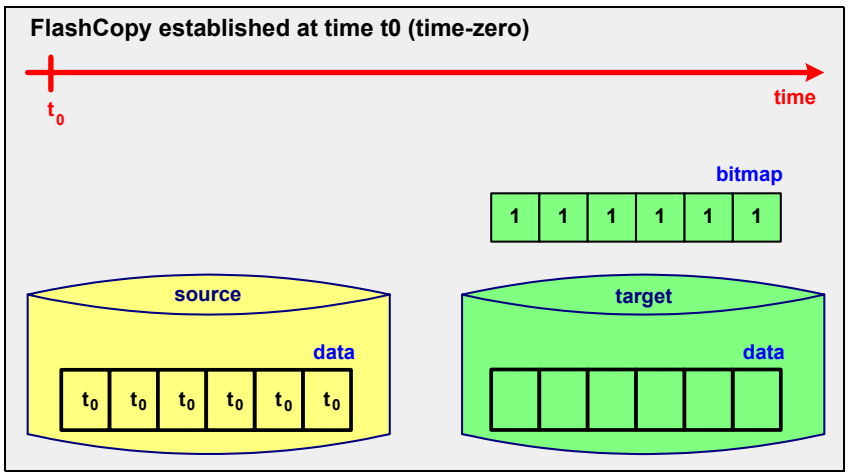

Figure 6-2 FlashCopy at time t0

Once the relationship has been established, it is possible to perform read and write I/Os on both the source and the target. Assuming that the target is used for reads only while production is ongoing, things will look as illustrated in Figure 6-3.

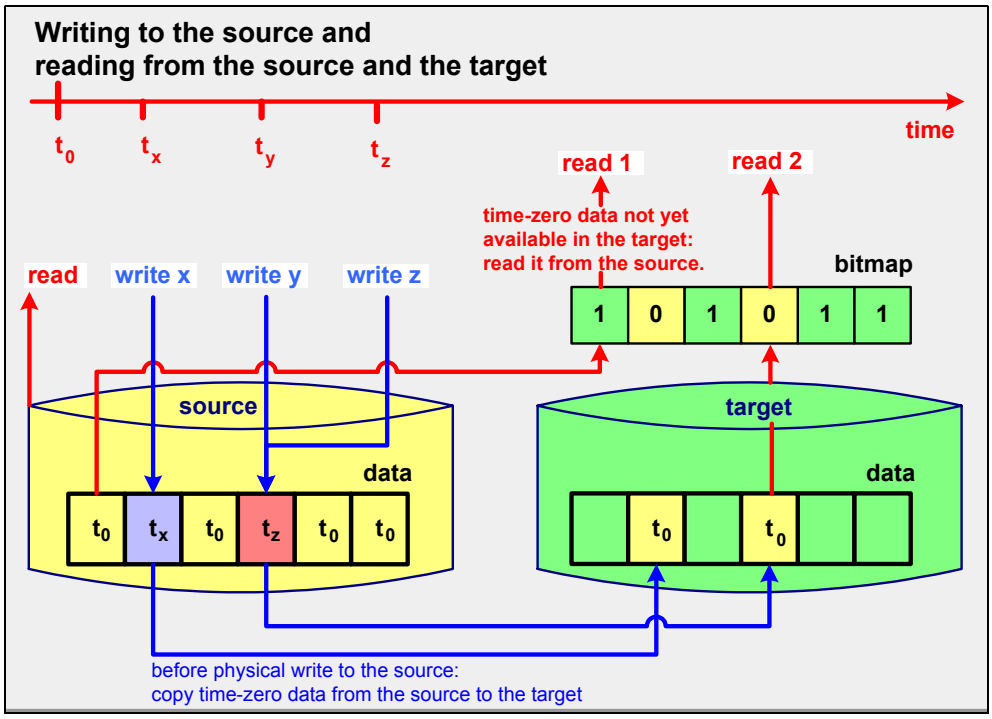

Figure 6-3 Reads from source and target volume and writes to source volume

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- **Reading from the source**

  The data is read immediately (see Figure 6-3 on page 46).

- **Writing to the source**

  Whenever data is written to the source volume while the FlashCopy relationship exists, the storage subsystem makes sure that the time-zero-data is copied to the target volume prior to overwriting it in the source volume.

  To identify if the data of the physical block on the source volume needs to be copied to the target volume, the bitmap is analyzed. If it identifies that the time-zero data is not available on the target volume, then the data will be copied from source to target. If it states that the time-zero data has already been copied to the target volume then no further action is done (see Figure 6-3).

  It is possible to use the target volume immediately—for reading data and also for writing data.

- **Reading from the target**

  Whenever a read-request goes to the target while the FlashCopy relationship exists, the bitmap is used to identify if the data has to be retrieved from the source or from the target. If the bitmap states that the time-zero data hasn't yet been copied to the target, then the physical read is directed to the source. If the time-zero data has already been copied to the target then the read will be performed immediately against the target (see Figure 6-3).

- **Writing to the target**

  Whenever data is written to the target volume while the FlashCopy relationship exists, the storage subsystem makes sure that the bitmap is updated. This way the time-zero data from the source volume never overwrites updates done directly to the target volume (see Figure 6-4).

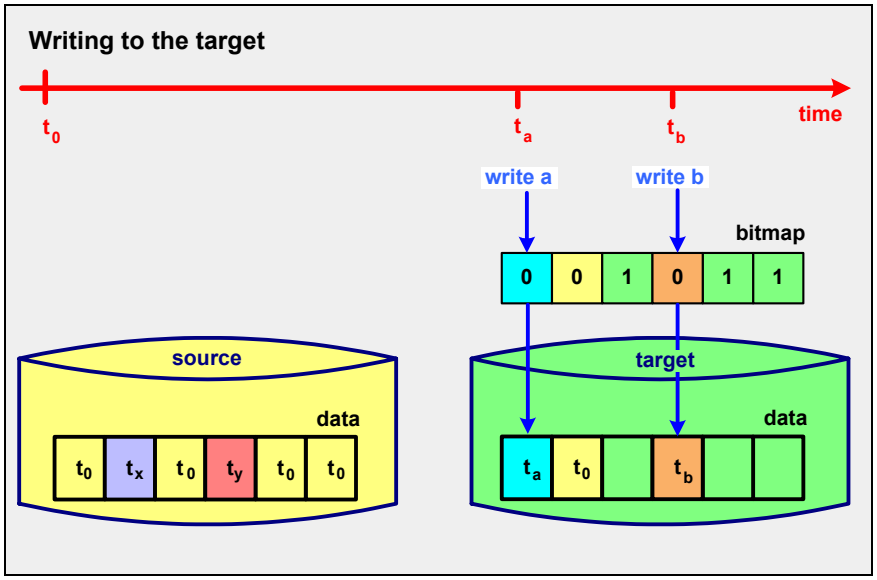

Figure 6-4 Writes to target volume

- **Terminating the FlashCopy relationship**

  The FlashCopy relationship is *automatically ended* when all tracks have been copied from the source volume to the target volume. The relationship can also be *explicitly withdrawn* by issuing the corresponding commands. If the *persistent* FlashCopy option was specified then the FlashCopy relationship must be withdrawn explicitly.

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6.3.1 Full volume copy

When the *copy* option is invoked and the establish process completes, a background process is started that copies all data from the source to the target. Once this process is finished and if there were no updates on the target, the picture we get is similar to the one in Figure 6-5. If not explicitly defined as *persistent*, the FlashCopy relationship ends as soon as all data is copied.

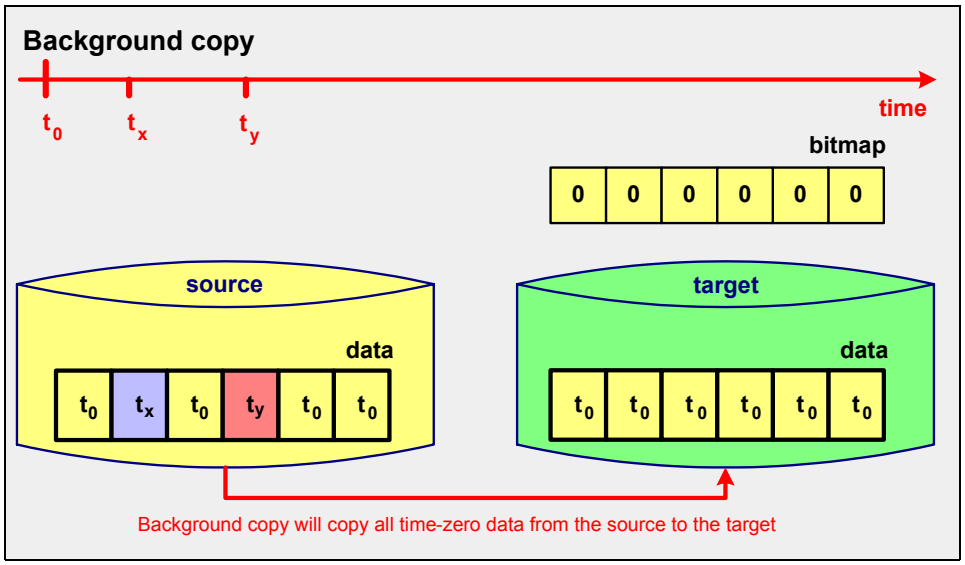

Figure 6-5 Target volume after a FlashCopy—copy—relationship ends

If there were writes to the target then the picture we get is similar to the one in Figure 6-6.

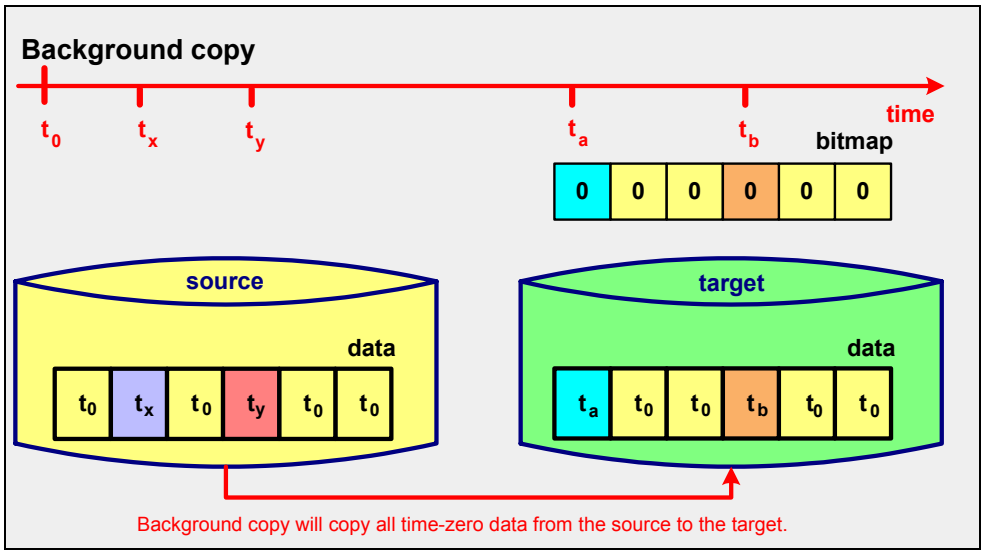

Figure 6-6 FlashCopy after updates to the target volume

6.3.2 Nocopy option

If FlashCopy is established using the *nocopy* option, then the result will be as shown in Figure 6-3 on page 46 and Figure 6-4 on page 47. The relationship will last until it is explicitly withdrawn or until all data in the source volume has been modified. Blocks for which no write

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occurred on the source or on the target will stay as they were at the time when the FlashCopy was established.

If the *persistent* FlashCopy option was specified, the FlashCopy relationship must be withdrawn explicitly.

6.4 FlashCopy in combination with other Copy Services

Volume-based FlashCopy can be used in various combinations with other Copy Services, whereas the most suitable will depend on the characteristics of the environment and the requirements.

Note: The scenarios discussed in the present section do not apply to data set FlashCopy.

6.4.1 FlashCopy and Metro Mirror

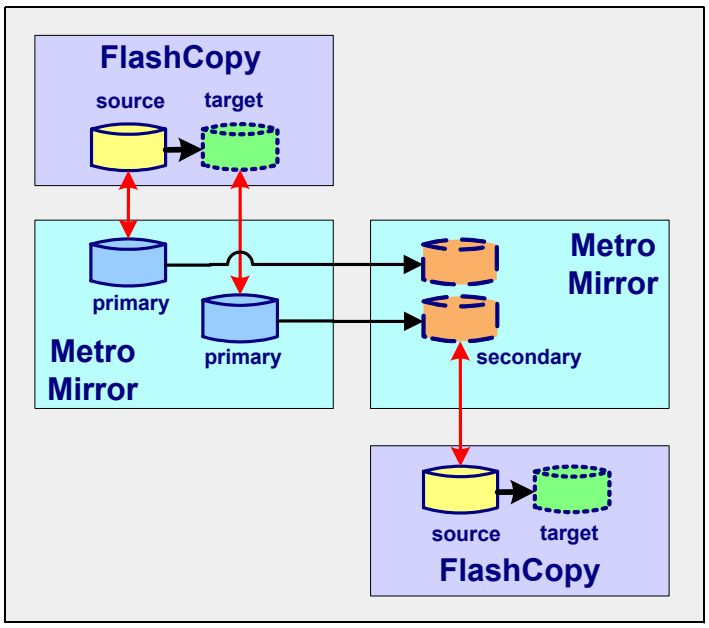

Figure 6-7 FlashCopy and Metro Mirror

As illustrated in Figure 6-7, the following combinations are supported at the primary Metro Mirror site:

- A FlashCopy *source volume* can become a Metro Mirror *primary volume* and vice versa. The order of creation is optional.
- A FlashCopy *target volume* can become a Metro Mirror *primary volume* and vice versa. If you wish to use a FlashCopy target volume as a Metro Mirror primary, be aware of the following considerations:
  - The recommended order is to first establish the Metro Mirror, and then create a FlashCopy to that Metro Mirror primary using the `-tgtpprc` parameter if using DS CLI, or TGTPPRIM(YES) if using TSO, or PPRCPRIM(YES) if using ICKDSF, or FCTOPPRCPrimary if using DFSMSdss.

    The Metro Mirror secondary will not be in a fully consistent state until the Metro Mirror enters the full duplex state.

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– If you create the FlashCopy first and then do a Metro Mirror of the FlashCopy target, you must monitor the progress of the FlashCopy background copy. In this case the following considerations apply:

  - The Metro Mirror secondary will not be in a fully consistent state until the FlashCopy background copy process is complete.
  - Use the *copy* option to ensure that the entire FlashCopy source volume data is copied to the Metro Mirror secondary.

On the secondary site of the Metro Mirror, a FlashCopy *source volume* can be the Metro Mirror *secondary volume* and vice versa. There are no restrictions on which relationship should be defined first.

6.4.2 FlashCopy and Global Copy

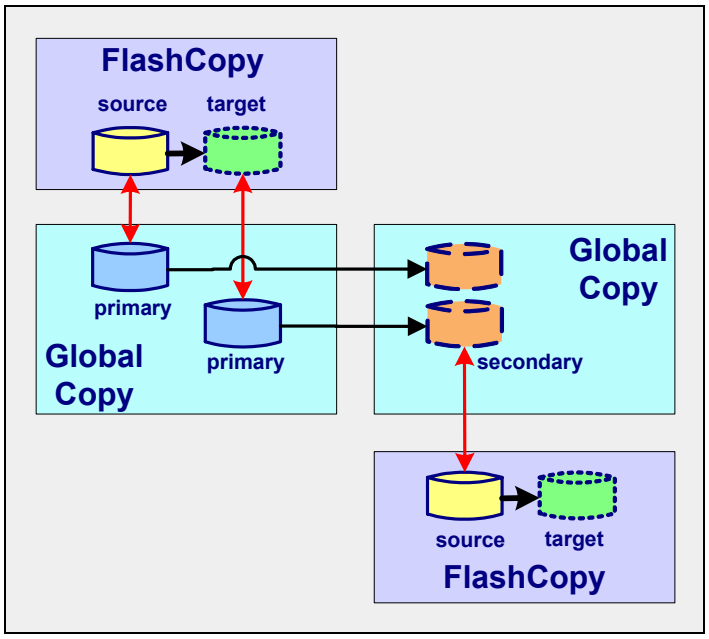

Figure 6-8 FlashCopy and Global Copy

As illustrated in Figure 6-8, at the primary Global Copy site the following combinations are possible:

- A FlashCopy *source volume* can become a Global Copy *primary volume* and vice versa. The order of creation is optional.
- A FlashCopy *target volume* can become a Global Copy *primary volume* and vice versa. If you wish to use a FlashCopy target volume as a Global Copy primary, be aware of the following considerations:

  – The recommended order is to first establish the Global Copy, and then create a FlashCopy to that Global Copy primary using the **`-tgtpprc`** parameter if using DS CLI, or TGTPPRIM(YES) if using TSO, or PPRCPRIM(YES) if using ICKDSF, or FCTOPPRCPrimary if using DFSMSdss.

    The Global Copy secondary will not be in a fully consistent state until the Global Copy is forced to the full duplex state.

  – If you create the FlashCopy first, and then do a Global Copy of the FlashCopy target, you must monitor the progress of the FlashCopy background copy.

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The Global Copy secondary will not be in a fully consistent state until the FlashCopy background copy process is complete and the Global Copy is forced to the full duplex state. Issue the TSO CESTPAIR command with OPTION(SYNC) to force the Global Copy to enter the full duplex state.

Use the *copy* option to ensure that the entire FlashCopy source volume data is copied to the Global Copy secondary.

On the Global Copy secondary site a FlashCopy *source volume* can be based on the *secondary* Global Copy volume.

6.4.3 FlashCopy and Global Mirror

FlashCopy in combination with Global Mirror supports only one type of relationship at the primary site; see Figure 6-9.

A FlashCopy source volume can become a Global Mirror primary volume and vice versa. The relationships can be established in any sequence. A FlashCopy target volume cannot become a Global Mirror primary volume.

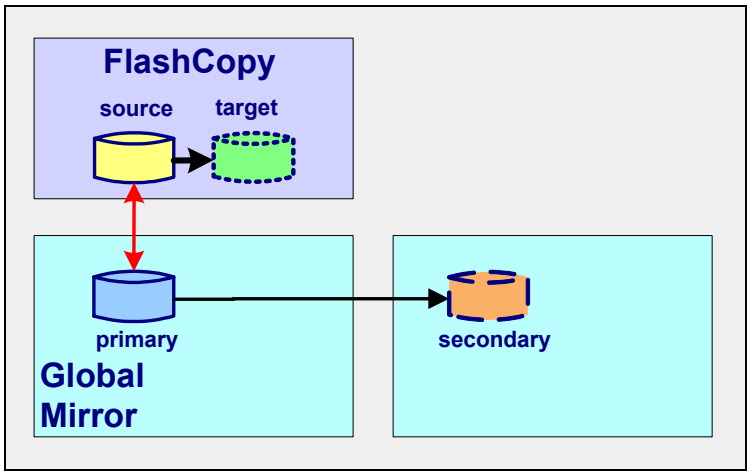

Figure 6-9 FlashCopy and Global Mirror

On the Global Mirror secondary site, the Global Mirror target volume cannot be used as FlashCopy source or FlashCopy target unless the Global Mirror pair is first suspended.

6.5 FlashCopy for z/OS data sets

The following applies when using FlashCopy for z/OS data sets (see Figure 6-10 on page 52):

- All types of z/OS data sets are supported (sequential, partitioned, and VSAM data sets).
- The source data set and the target data set can reside on the same or on different volumes.
- Within the volumes to which they belong, the source data set and the target data set can have different relative locations.

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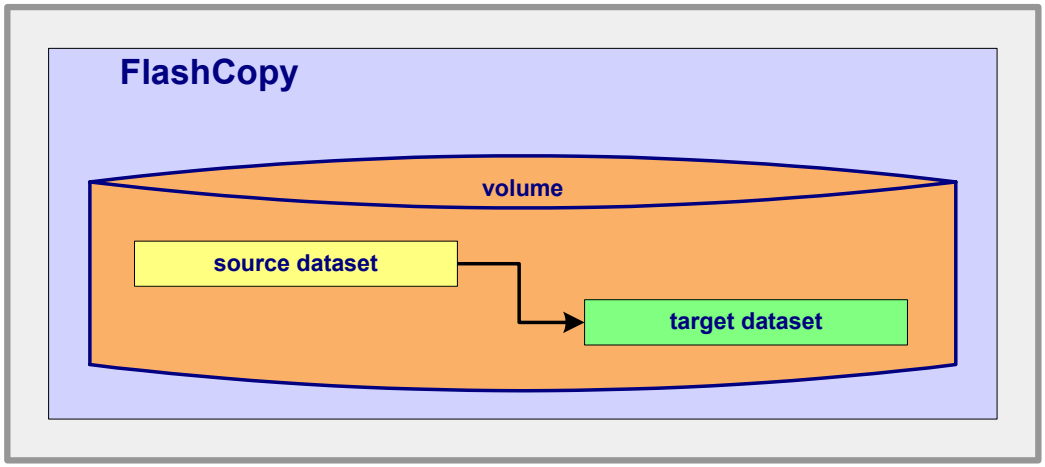

Figure 6-10 Source data set and target data set can reside in the same volume

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7

FlashCopy options

This chapter discusses the options of FlashCopy when working with IBM System Storage DS6000 series in a System z environment. The following options are explained:

- Multiple relationship FlashCopy
- Consistency Group FlashCopy
- FlashCopy on existing Metro Mirror or Global Copy source
- Incremental FlashCopy
- Remote FlashCopy
- Persistent FlashCopy
- Data set FlashCopy
- Reverse restore and fast reverse restore

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7.1 Multiple relationship FlashCopy

It is possible to establish up to 12 FlashCopy relationships using the same source. In other words, a source volume can have up to 12 target volumes. However, a target volume can still only have one source. Furthermore, cascading FlashCopy is not allowed (that is, a volume cannot be both a source and a target volume).

Following is a summary of the considerations that apply:

- A FlashCopy source volume can have up to 12 FlashCopy target volumes.

  Note: Only one of those targets can be defined as incremental FlashCopy.

- For each source volume, only one FlashCopy relationship can be reversed (the one that has been established with the TSO FCESTABL command and INCREMENTAL(YES) option).
- A FlashCopy target volume can have only one FlashCopy source volume.
- A FlashCopy target volume cannot be a FlashCopy source volume at the same time.

Note: At any point in time, a volume, or a data set, can only be a source or a target.

Figure 7-1 illustrates what is possible and what is not with multiple relationship FlashCopy.

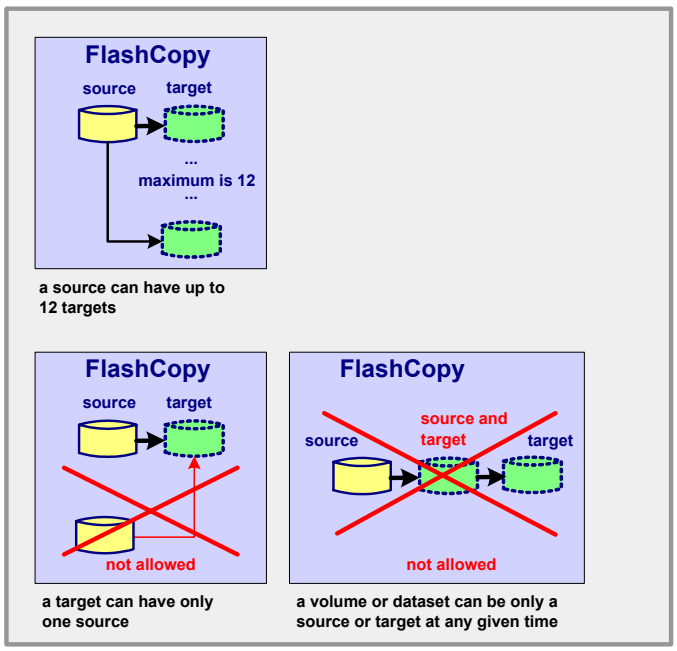

Figure 7-1 Multiple relationship FlashCopy possibilities

Multiple relationship FlashCopy at the data set level

Multiple relationship FlashCopy is also supported at the data set level, though not all interfaces that support the multiple relationship FlashCopy will support multiple relationships at the data set level. In Figure 7-8 on page 61 we see that neither the DS Storage Manager nor the DS CLI support multiple relationships at the data set level. Also in Figure 7-8 on page 61, as stated in Note 1, it is important to point out that though TSO and the ANTRQST

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API support data set level FlashCopy, the VTOC and catalogs are not updated as they are with DFSMSdss.

7.2 Consistency Group FlashCopy

Applications might have their data spread over multiple volumes. In this case, if FlashCopy needs to be used for multiple volumes, these all have to be at a consistent level. Consistency groups can be used to help create a consistent point-in-time copy across multiple volumes, and even across multiple DS6000 storage systems, thus managing the consistency of dependent writes.

It is possible to establish a consistency group using those interfaces that support this function (see Figure 7-8 on page 61). If using TSO commands, then the TSO FCESTABL command with ACTION(FREEZE) option should be used, specifying all FlashCopy pairs belonging to the Consistency Group.

Dependent writes

If the start of one write operation is dependent upon the completion of a previous write, the writes are *dependent*. Application examples for dependent writes are databases with their associated logging files. Also updates to catalogs, VTOCs as well as VSAM indexes, and VSAM data components rely on dependent writes. For instance, the database logging file will be updated after a new entry has been successfully written to a table space.

The chronological order of dependent writes to the FlashCopy source volumes is the basis for providing consistent data at the FlashCopy target volumes. For a more detailed understanding of *dependent writes* and how *extended long busy* conditions enable the creation of consistency groups, thus ensuring data integrity on the target volumes, you can refer to the discussion in 13.3.1, “Data consistency and dependent writes” on page 136.

With the *Freeze* FlashCopy Consistency Group option, the DS6000 will hold off I/O activity to a volume for a time period by putting the source volume in *extended long busy* state. Thus, a time slot can be created during which the dependent write updates will not occur, and FlashCopy will use that time slot to obtain a consistent point-in-time copy of the related volumes. I/O activity resumes when all FlashCopies are established, and the *thaw* functionality (the TSO FCWITHDR command with the ACTION(THAW) option) is invoked, or when the extended long busy (ELB) time slot expires (the ELB window is 2 minutes by default).

7.3 FlashCopy target as a Metro Mirror or Global Copy primary

With this option the FlashCopy target volume can also be a primary volume for a Metro Mirror or Global Copy relationship. A user may wish to use this capability to create both a remote copy and a local copy of a production volume.

Figure 7-2 on page 56 illustrates this capability. In this figure, the FlashCopy target and the Metro Mirror (or Global Copy) primary are the same volume. They are displayed as two separate volumes for ease of understanding.

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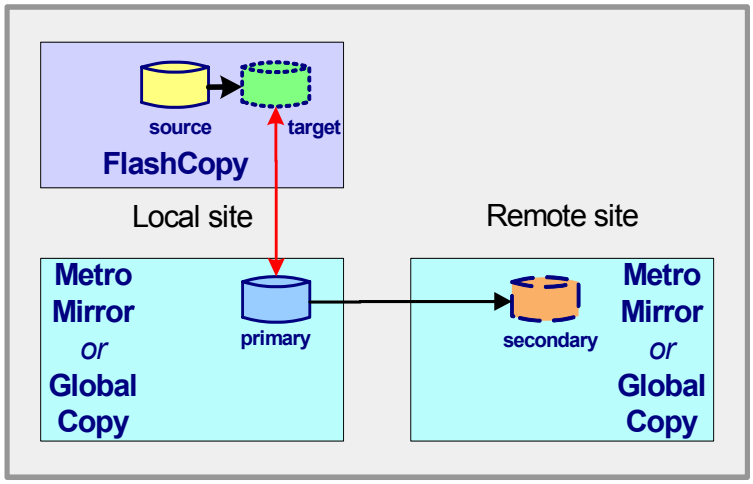

Figure 7-2 FlashCopy target is Metro Mirror (or Global Copy) primary

It is possible to create either the FlashCopy relationship first or the Metro Mirror (or Global Copy) relationship first. However, in general it is better to create the FlashCopy relationship first to avoid the initial sending of unnecessary data across to the Metro Mirror (or Global Copy) secondary.

7.4 Incremental FlashCopy - refresh target volume

Incremental FlashCopy provides the capability to *refresh* a FlashCopy relationship, thus refreshing the target volume.

Attention: A refresh of the target volume will always overwrite any writes previously done to the target volume.

Restriction: If a FlashCopy source has multiple targets, an incremental FlashCopy relationship can be established with one and only one target.

In order for an Incremental FlashCopy to be performed, the FlashCopy relationship must first be established with the *Start Change Recording* and *Persistent FlashCopy* options enabled.

If Incremental FlashCopy is invoked via the ANTRQST API or the TSO FCESTABL command with the INCREMENTAL(YES) option, the FlashCopy target is write-inhibited. Any attempt to write to the device during this period will be failed by the hardware and surfaced as an I/O error, an error from the access method, or both.

Note: Incremental FlashCopy is supported at volume level, not for data set FlashCopy.

With Incremental FlashCopy, the initial FlashCopy—*copy* or *nocopy*—relationship between a source and target volume is subject to the following (see Figure 7-3 on page 57):

- FlashCopy with nocopy option

  If the original FlashCopy was established with the *nocopy* option, then the bitmap for the target volume will be reset, and, of course, the updates on the target volumes are overwritten. However, using the incremental option will automatically convert this relationship to a *copy* relationship, and the background copy will begin.

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- FlashCopy with copy option

  If the original FlashCopy was established with the *copy* option (full volume copy), then the updates that took place on the source volume since the last FlashCopy will be copied to the target volume. Also, the updates done on the target volume will be overwritten with the contents of the source volume.

.

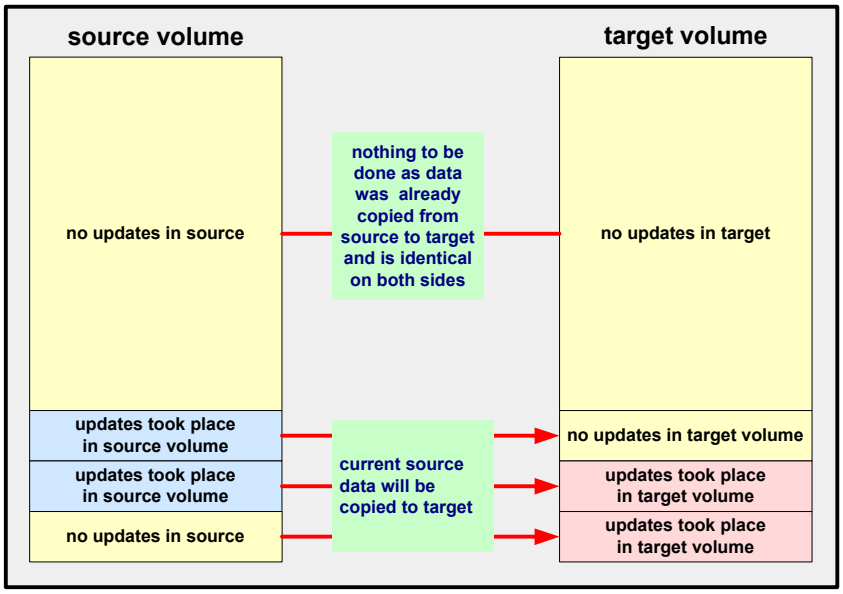
source volume
target volume
no updates in source
nothing to be done as data was already copied from source to target and is identical on both sides
no updates in target
updates took place in source volume
updates took place in source volume
no updates in source
current source data will be copied to target
no updates in target volume
updates took place in target volume
updates took place in target volume

Figure 7-3 Updates to the target volume caused by a refresh

When initializing a FlashCopy with *Start Change Recording* activated, a second and third bitmap will be used to identify writes done to the source or the target volume (see Figure 7-4).

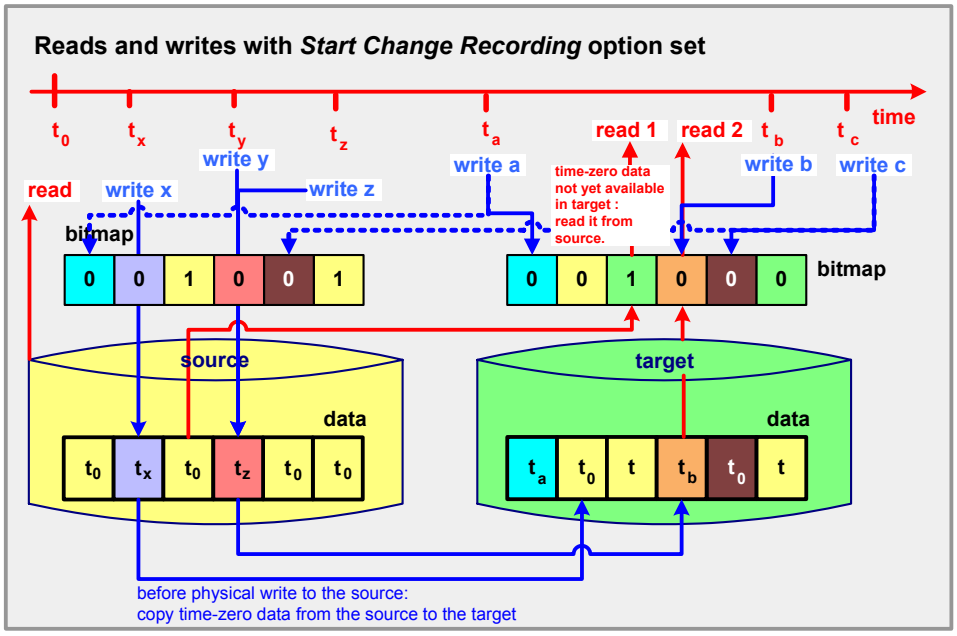

Figure 7-4 FlashCopy with Start Change Recording set

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All three bitmaps are necessary for incremental FlashCopy:

- Target bitmap - This bitmap keeps track of tracks not yet copied from source to target.
- Source Change Recording bitmap - This bitmap keeps track of changes to the source.
- Target Change Recording bitmap - Yhis bitmap keeps track of changes to the target.

These bitmaps allow subsequent FlashCopies to transmit only those blocks of data for which updates occurred. Every write operation to the source or target volume will be reflected in these bitmaps by setting the corresponding bit to 0.

When the *Refresh* takes place, the bitmap used for *change recording* is used to analyze which blocks need to be copied from the source volume to the target volume (see Figure 7-5).

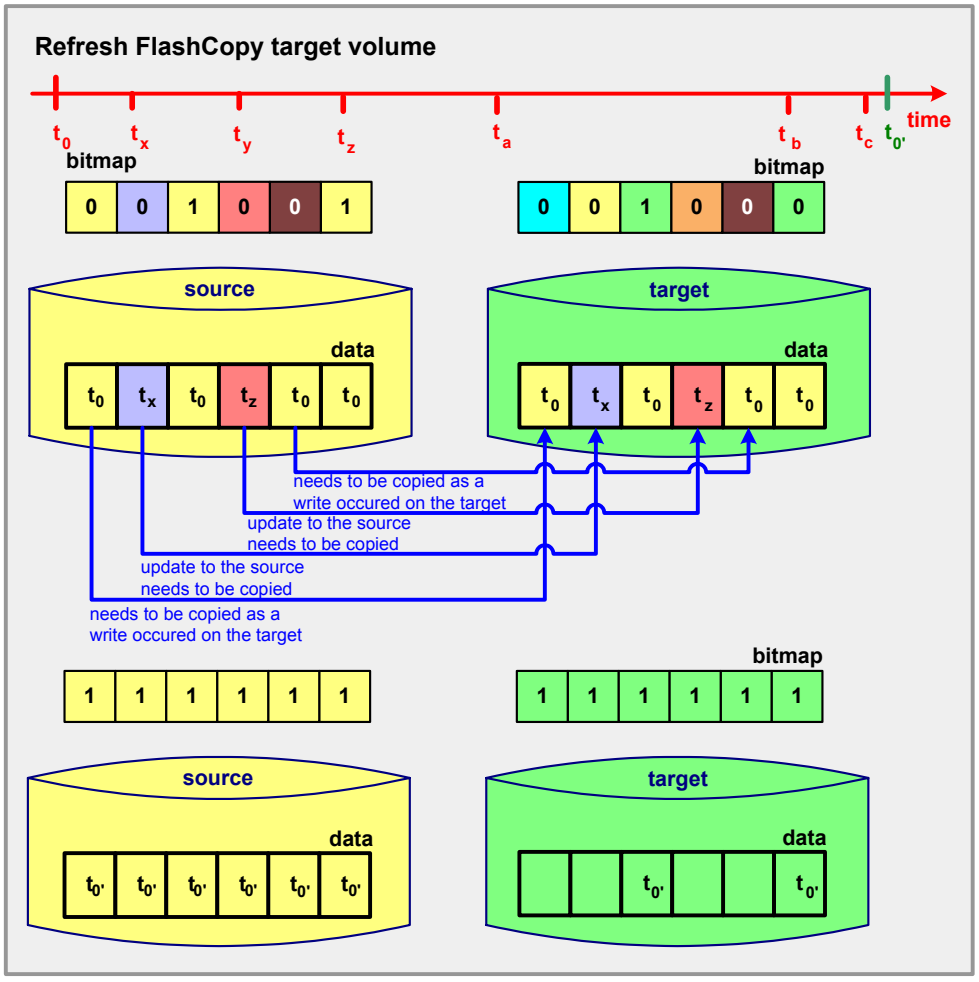

Figure 7-5 Refresh of the FlashCopy target volume

After the *Refresh*—which takes place only on the bitmap level—the new FlashCopy based on time-0' is active. The copy of the time-0' data to the target is done in the background.

Tip: You can do the incremental copy at any time. You do not have to wait for the previous background copy to complete.

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7.5 Remote FlashCopy

There are command interfaces (see Figure 7-8 on page 61) which are able to manage a FlashCopy relationship at a remote site. The commands can be issued from the local site and they are then transmitted over the Metro Mirror or Global Copy links. This eliminates the need for a network connection to the remote site solely for the management of FlashCopy.

The FlashCopy source volume at the remote site must be the secondary volume of the Metro Mirror or Global Copy pair.

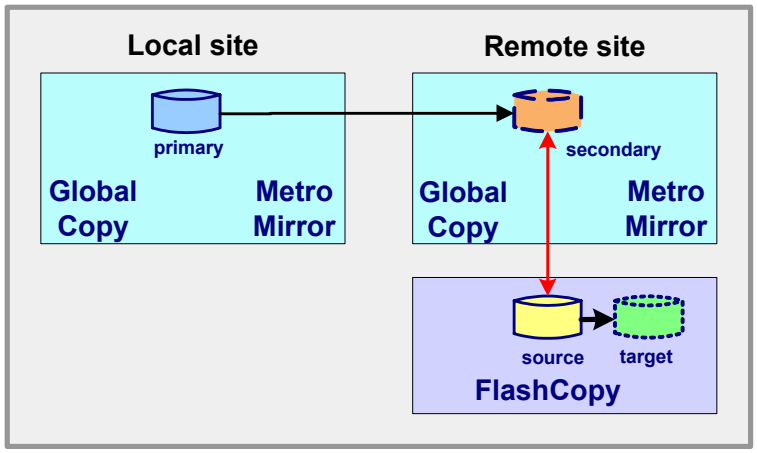

Figure 7-6 Remote FlashCopy

Figure 7-6 illustrates this capability. In this figure, the Metro Mirror (or Global Copy) secondary and the FlashCopy source are the same volume—they are shown as two separate volumes for ease of understanding.

7.6 Persistent FlashCopy

With this option the FlashCopy relationship continues until explicitly removed, that is, until the user terminates the relationship using one of the interface methods. If this option is not selected, the FlashCopy relationship will exist until all data has been copied from the source volume to the target.

7.7 Data set FlashCopy

Data set FlashCopy is supported with z/OS and OS/390® volumes only. This option can be invoked using the interfaces that support data set FlashCopy as per Figure 7-8 on page 61. The following are characteristics of data set FlashCopy:

- The data set source and target volumes need not be the same size.
- The location within the target volume need not match the location within the source.
- Data sets can be copied onto the same source volume.
- Multiple relationship FlashCopy is supported with Data set FlashCopy.
- If a Data set FlashCopy relationship, established with DFSMSdss and with the *nocopy* parameter, is deleted, DADSM (the Direct Access Device Space Management component of z/OS) will start a background copy prior to deleting the data set. When all data is copied successfully, the FlashCopy relationship will end and the data set will finally be deleted.

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7.8 Reverse restore

With this option the FlashCopy relationship can be reversed by copying over modified tracks from the target volume to the source volume (see Figure 7-7). The background copy process must complete before you can reverse the order of the FlashCopy relationship to its original source and target relationship. Change recording is a prerequisite for reverse restore.

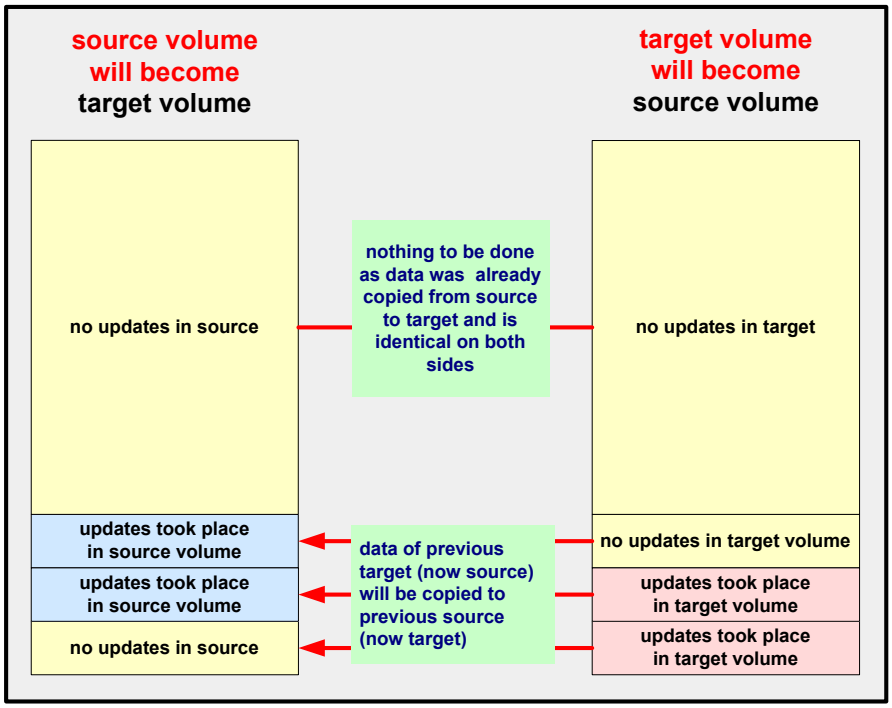
source volume
will become
target volume
target volume
will become
source volume
no updates in source
nothing to be done as data was already copied from source to target and is identical on both sides
no updates in target
updates took place in source volume
updates took place in source volume
no updates in source
data of previous target (now source) will be copied to previous source (now target)
no updates in target volume
updates took place in target volume
updates took place in target volume

Figure 7-7 Reverse restore

The source and target bitmaps (illustrated in Figure 7-4 on page 57) are exchanged and then handled as described with the Incremental FlashCopy option.

7.9 Fast reverse restore

This option is used with Global Mirror. If you specify this option, you can reverse the FlashCopy relationship without waiting for the completion of the background copy of the previous FlashCopy.

7.10 Options and interfaces

Now that we have discussed the options available with FlashCopy, let us see how the DS6000-provided interfaces and the z/OS-provided interfaces support them; see Figure 7-8 on page 61.

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Function \ Interface	DS front ends		zOS front ends			
	DS SM	DS CLI	DFSMSdss	TSO	ANTRQST	ICKDSF
Multiple relationship FlashCopy	✓	✓	✓	✓	✓	✓
Consistency Group FlashCopy	✗	✓	✓ (3)	✓	✓	✓
Target on existing Metro Mirror or Global Copy primary	✓	✓	✓	✓	✓	✓
Incremental FlashCopy	✓	✓	✓ (3)	✓	✓	✓
Remote FlashCopy	✗	✓	✗	✓	✓	✓
Persistent Flashcopy	✓	✓	✓ (2) (3)	✓ (2)	✓ (2)	✗
Dataset FlashCopy	✗	✗	✓	✓ (1)	✓ (1)	✗
Reverse restore, fast reverse restore	✓	✓	✗	✓	✓	✓

(1) Extents can be specified, but the VTOC and the catalogs are not updated

(2) Persistent relationships are available via Incremental support

(3) With z/OS V1R6 or later, and APARs OA11002, OA12707, OA12748, and OA14105

Figure 7-8 FlashCopy options and interfaces

Note that there are some options that cannot be invoked with some of the interfaces—they are indicated with a cross in Figure 7-8.

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8

FlashCopy ordering and activation

This chapter explains how to order and activate FlashCopy for the IBM System Storage DS6000. The information presented here can be complemented with the information in Appendix C, “Licensing” on page 525.

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8.1 Ordering FlashCopy

FlashCopy is an optional licensed function of the IBM System Storage DS6000 series. This function is also referred to as the Point-In-Time Copy (PTC) *licensed function*.

Note: For a detailed explanation of the features involved and the factors to be considered when ordering FlashCopy we recommend you refer to the IBM System Storage DS6000 Series (IBM 1750-522) announcement letter.

IBM announcement letters can be found at:

http://www.ibm.com/products

All DS6000 series licensed functions are enabled, authorized, managed, activated, and enforced based upon the physical capacity contained in a 1750 system.

Enablement

This refers to the purchase of a feature number to technically activate the associated licensed function. Each licensed function is *enabled* for a 1750 system through acquiring the corresponding feature numbers.

Particularly for FlashCopy, the 1750 feature that must be ordered is the Point-in-Time Copy (PTC) licensed function, feature #52xx; see Table 8-1.

Table 8-1 FlashCopy features

Feature	Description
5210	PTC - 1 TB
5211	PTC - 5 TB
5212	PTC - 10 TB
5213	PTC - 25 TB
5214	PTC - 50 TB

Each licensed function feature number purchased for a 1750 machine enables that function for the entire 1750 system.

Authorization

This refers to the purchase of a feature number to establish the extent of IBM *authorization* —license size in terms of physical capacity— for use of an associated licensed function. This is also referred to as the *authorization level*.

The extent of IBM authorization for the use of a licensed function on a 1750 system is established by acquiring an 52xx feature number on the 1750 base enclosure. The same 52xx feature numbers acquired to enable a licensed function also establish the extent of IBM's authorization.

The 52xx feature number on a 1750 base enclosure establishes the authorization level for the entire 1750 system. For example, a 1750 system with a Model 522 base enclosure and two Model EX2 expansion enclosures requires the acquisition of 52xx feature numbers only on the Model 522. Therefore, for licensed functions authorized on the basis of physical capacity—as in the case of PTC—the authorization level established with the acquisition of the 52xx feature number on the Model 522 must also cover the physical capacity of the attached Model EX2 expansion enclosures.

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8.2 Activating FlashCopy

IBM System Storage DS6000 licensed functions are managed using the Disk Storage Feature Activation (DSFA) application. Also, the DS6000 licensed functions are activated by the installation of feature activation codes into the 1750 system.

The feature activation codes are made available by IBM and are obtained using the DSFA (Disk Storage Feature Activation) application at:

`http://www.ibm.com/storage/dsfa`

For additional information on the activation of the DS6000 licensed function features, see Appendix C, “Licensing” on page 525.

8.2.1 Management

The Disk Storage Feature Activation (DSFA) application can be used to:

- Assign an order confirmation code
- Select the license scope
- Assign the license value
- Deactivate a licensed function

These activities are referred to as the “management” activities that you can perform with the DSFA application and in relation to the DS6000 licensed functions.

Order confirmation code

With the purchase of the 52xx feature number, IBM provides an order confirmation code. To activate the function in your machine, you must assign the order confirmation code to your 1750 system (using the 1750 base enclosure serial number). This activity is performed using the DSFA application.

You will not be able to retrieve a feature activation code for a purchased licensed function until you have assigned the order confirmation code to the serial number of the 1750 for which it was acquired.

License scope

Licensed functions are activated and enforced within a defined *license scope*. License scope refers to the type of storage, and therefore the type of servers, that the function can be used with:

- Fixed Block (FB): the function can be used only with data from Fibre Channel-attached servers.
- Count Key Data (CKD): the function can be used only with data from FICON-attached servers.
- Both FB and CKD (ALL): the function can be used with data from all attached servers.

In particular the license scope of FlashCopy is multiple: it can either be FB, CKD, or ALL. For this reason, when ordering FlashCopy, you must plan ahead what your point-in-time copy requirements will be. Example 8-1 on page 66 illustrates a sample case.

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Example 8-1 FlashCopy example

```
A DS6000 has a total physical capacity of 15 TB and that capacity will be configured as:
     10 TB open systems (FB)
     5 TB System z (CKD)
Then, here's the required licenses:
Operating environment ==> 15 TB (equal to total machine capacity)
Parallel access volumes ==> 5 TB (equal to CKD-configured capacity)
Remote mirror for z/OS ==> 5TB (equal to CKD-configured capacity)

FlashCopy must either be:
     10 TB if you want to use FlashCopy only with open systems (FB) data (equal to
FB-configured capacity)
     5 TB if you want to use FlashCopy only with System z (CKD) data (equal to
CKD-configured capacity)
     15 TB if you want to use FlashCopy with both open systems (FB) and System z (CKD) data
(equal to total machine capacity)
```

If a licensed function—as is the case with FlashCopy—has multiple license scope options, you will be required to select a license scope during the initial retrieval of the feature activation code.

Note: The license scope is not selected during the purchase of the 52xx feature number; the feature numbers only establish the extent of IBM authorization (in terms of physical capacity) regardless of the storage type.

You can also change the license scope using the DSFA application after a licensed function has been activated. A new feature activation code will be generated and when you install it into the machine, the function will be activated and enforced using the newly selected license scope. Only an increase in the license scope (changing FB or CKD to ALL) is a nondisruptive activity. A lateral change (changing FB to CKD or changing CKD to FB) or a reduction of the license scope (changing ALL to FB or CKD) is a disruptive activity and requires a machine IML.

License value

Licensed functions are activated and enforced based upon an assigned license value.

License value refers to the extent of IBM authorization and is referenced as either of the following:

- Terabytes (TB) of physical capacity for variable-sized licensed functions
- ON or OFF for system-level licensed functions

Feature activation codes will always be generated using the total license value for each variable-sized licensed function and ON for each system-level licensed function, unless you assign a license value of zero (0.0 TB) or OFF, respectively.

You can change the license value assignment using the DSFA application. You would generally only perform this activity when you want to deactivate a licensed function.

Deactivation

Assigning a license value of zero (0.0 TB) or OFF provides the ability to deactivate (disable) a licensed function. A new feature activation code will be generated and when you install it into the machine, the function will be deactivated during the next IML of the machine.

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You can also reactivate a deactivated licensed function by changing the license value to a non-zero value. A new feature activation code will be generated and when you install it into the machine, the function will be activated. Reactivation is a nondisruptive activity.

When you deactivate a licensed function using the DSFA application, the 5xxx feature numbers assigned to your machine (using the order confirmation code) remain assigned to the machine. This means that you do not need to repurchase your 5xxx feature numbers if you want to reactivate the licensed function at a future date.

8.2.2 Activation

Activation refers to the client retrieval and installation of the feature activation code into the 1750 system.

The feature activation code is made available by IBM and obtained using the DSFA application at:

`http://www.ibm.com/storage/dsfa`

Note: To access DSFA, you will be required to enter information about your 1750 machine. You can find this information on the Storage Unit General Properties page in the DS6000 series Storage Manager application.

The following information is needed for the download of the keyfile and should be prepared during planning:

- Model
  The model of the DS6000 can be taken from the order.
- Serial number of the DS6000
  The serial number of a DS6000 can be taken from the front of the base frame (lower right corner). If several servers have been delivered, this is the only way to obtain the serial number of a DS6000 located in a specific point in the computer center.
- Machine signature
  The machine signature can only be obtained with the DS SM or the DS CLI after installation of the DS6000. In a Web browser, type the URL of the DS SMC:

  `https://10.10.10.10:8452/DS6000`

  Select **Real-time manager** → **Monitor system** → **Properties.** Select **General**, then the Storage Complex and the Storage Unit that you are interested in from the list. This shows the properties of the selected DS6000, including the machine signature.
- **Order confirmation code**
  The order confirmation code is printed in the DS6000 series order confirmation code document, which is sent to the client's contact person either with the DS6000 or before delivery.

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9

FlashCopy interfaces

The setup of FlashCopy in a System z environment can be done using different interfaces. This chapter explains and gives examples of the interfaces that can be used for FlashCopy management when FlashCopy is used with the IBM System Storage DS6000 in a System z environment.

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9.1 FlashCopy interfaces - overview

There are various interfaces that can be used for the configuration and management of FlashCopy when used in a System z environment with the DS6000.

There are the DS6000 front end-provided interfaces:

- DS Storage Manager (DS SM) - A graphical user interface (GUI) running in a Web browser that communicates with the DS6000 Storage Management Console (DS SMC).
- DS Command Line Interface (DS CLI) - Provides a set of commands that are executed on a supported workstation communicating with the DS SMC.
- TotalStorage Productivity Center for Replication (TPC for Replication) - The TPC Replication Manager server connects to the same network where the DS SMC is.
- DS Open Application Programming Interface (DS Open API).

Also, with z/OS the following interfaces can be used for FlashCopy management:

- DFSMSdss utility
- TSO commands
- ICKDSF utility
- ANTRQST application programming interface (API)

This chapter gives an overview of the DS CLI and the DS SM, as well as the z/OS-provided interfaces. These interfaces are also covered in Part 2, “Interfaces” on page 15.

TotalStorage Productivity Center for Replication (TPC for Replication) provides management of DS6000 series business continuance solutions, including FlashCopy, Metro Mirror, and Global Mirror. TPC for Replication is covered in Chapter 31, “IBM TotalStorage Productivity Center for Replication” on page 467. TPC for Replication includes similar functions to Global Mirror Utility (GMU). GMU users should consider migrating to TPC for Replication.

Also, the DS Open Application Programming Interface (DS Open API), which is a set of application programming interfaces that are available to be integrated in programs, can be used for FlashCopy management and control. The DS Open API is not covered in this book. For information on the DS Open API, refer to *IBM System Storage DS Open Application Programming Interface Reference*, GC35-0516.

FlashCopy control with the interfaces

Independently of the interface that is used, when managing FlashCopy the following basic sequence takes place:

1. FlashCopy is initiated by means of an interface.

   The initialization process of a FlashCopy takes only some seconds. At the end of this process FlashCopy is established based on the given parameters. This means that all the necessary meta structures have been established. No data has yet been copied.

2. FlashCopy runs in the background.

   This is the moment when FlashCopy copies—in the background—the necessary data to create the point-in-time copy. The parameters given at initialization time define how FlashCopy will work in the background. They also define which subsequent activities can be performed with this FlashCopy.

3. FlashCopy terminates.

   FlashCopy either terminates automatically if all tracks have been copied, or needs to be terminated explicitly, by means of an interface, if it has been defined as persistent.

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9.2 DS CLI and DS SM - commands and options

This section summarizes the *commands* and *select options* you can use when managing FlashCopy at the local and at the remote site.

9.2.1 Local FlashCopy management

The commands you can use as well as the displayed panel actions and options you can select when working with the DS6000-provided interfaces DS CLI and DS SM for local FlashCopy management are listed in Table 9-1.

Local FlashCopy refers to the situation where the FlashCopy is local as opposed to a remote FlashCopy. For a discussion of the characteristics of a remote FlashCopy refer to Section 7.5, “Remote FlashCopy” on page 59.

Table 9-1 Local FlashCopy using DS CLI and DS SM

Options	Command with DS CLI	Select option with DS SM
Create a FlashCopy		
Create a local FlashCopy	mkflash	Create
Work with an existing FlashCopy		
Display a list of FlashCopy relationships	lsflash	Main panel
Modify a FlashCopy pair that is part of a Global Mirror relationship to revertible	setflashrevertible	Restorable, Record Changes wizard
Commit data to the target volume	commitflash	
Increment an existing FlashCopy pair	resyncflash (prerequisites: -record and -persist)	Resynch target
Change the source-target-relationship A->B to B->A	reverseflash	Reverse relationship
Re-establish contents of target B by contents of source A as it was during last consistency formation	revertflash	Consistency Groups not supported
Reset a FlashCopy Consistency Group	unfreezeflash	Consistency Groups not supported
Run new background copy for persistent FlashCopy	rmflash -cp	Background copy
Terminate FlashCopy		
Remove local FlashCopy	rmflash	Delete
	Is automatically removed as soon as all data is copied and FlashCopy pair wasn’t established using the -persist parameter	

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9.2.2 Remote FlashCopy management

The commands that can be used when working with the DS6000-provided interface DS CLI for remote FlashCopy management are listed in Table 9-2.

Table 9-2 Remote FlashCopy using DS CLI commands

Options	Command with DS CLI
Create a FlashCopy	
Create a remote FlashCopy	mkremoteflash
Work with an existing FlashCopy	
Display a list of FlashCopy relationships	lsremoteflash
Modify a FlashCopy pair that is part of a Global Mirror relationship to revertible	setremoteflashrevertible
Commit data to the target volume	commitremoteflash
Increment an existing FlashCopy pair	resyncremoteflash (prerequisites: -record and -persist)
Change the source-target- relationship A->B to B->A	reverseremoteflash
Re-establish contents of target B by contents of source A as it was during last consistency formation	revertremoteflash
Reset a FlashCopy Consistency Group	not available as remote command
Run new background copy for persistent FlashCopy	rmremoteflash -cp
Terminate FlashCopy	
Remove local FlashCopy	rmremoteflash
	Is automatically removed as soon as all data is copied and FlashCopy pair wasn't established using the -persist parameter

Note: Remote FlashCopy is not supported with the DS SM or DS Open API interfaces.

9.3 z/OS-provided interfaces

When working in a z/OS environment the operating system provides you with utilities and commands for local FlashCopy management. Table 9-3 summarizes the commands for the different FlashCopy functions.

Table 9-3 Local FlashCopy using DFSMSdss, TSO, and ICKDSF commands

Options	Command with DFSMSdss	Command with TSO	Command with ICKDSF
Create a FlashCopy			
Create a volume FlashCopy	COPY FULL	FCESTABL	FLASHCPY ESTABLISH
Create a Data set FlashCopy	COPY DATASET		

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Options	Command with DFSMSdss	Command with TSO	Command with ICKDSF
Work with an existing FlashCopy			
Display a list of FlashCopy relationships		FCQUERY	FLASHCPY QUERY RELATION
Relocate data set extents on a DASD volume	DEFRAG	-	
Provide information why DFSMSdss couldn't use FlashCopy	DEBUG	-	
Terminate FlashCopy			
Remove local FlashCopy	DUMP with FCWITHDRAW parameter	FCWITHDR	FLASHCPY WITHDRAW
	Is automatically removed as soon as all data is copied and FlashCopy pair wasn't established using the -persist parameter		

9.4 Local FlashCopy using the DS CLI

The DS CLI can be downloaded from the IBM Web site and then installed on a workstation. It communicates with the DS SMC. For detailed information about the DS CLI, refer to *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922.

9.4.1 Parameters used with local FlashCopy commands

Parameters	DS CLI Commands								
	mkflash	lsflash	setflash revertible	commit flash	resync flash	reverse flash	revert flash	unfreeze flash	rmflash
Source									
freeze	x				x				
Target									
tgtpprc	x				x	x			
tgtoffline	x		x		x	x			
tgtinhibit	x				x	x			
tgtonly									x
Flashcopy pair									
dev	x	x	x	x	x	x	x	x	x
record	x	x			x	x			
persist	x	x			x	x			
nocp	x								
seqnum	x	x	x	x	x	x	x		x
source:target	x	x			x				x
fast						x			
source				x			x		
cp		x							x
source LSS								x	
l		x							
s		x							
activecp		x							
revertible		x							
Command									
wait	x								
quiet									x

Figure 9-1 Overview of parameters used in DS CLI FlashCopy commands

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This section discusses the parameters that can be passed to FlashCopy when using the DS CLI and what the results are. Figure 9-1 summarizes the parameters and the corresponding DS CLI commands. When FlashCopy receives these parameters, the following actions result:

- **freeze**: Consistency Group FlashCopy

  With the DS CLI, it is possible to establish a Consistency Group by using the **-freeze** parameter and identifying all FlashCopy pairs and target volumes belonging to it.

- **tgtpprc**: establish target on existing Metro Mirror source

  When this option is selected, the target volume can be, or can become, a source volume for a Metro Mirror or Global Copy relationship.

- **tgtoffline**: permit FlashCopy to occur if target volume is not online for host access

  When setting up the relationship, a verification is done to see whether the target volume is online or offline. This parameter only applies to CKD volumes. Table 9-4 summarizes the actions that result, depending on the target volume status.

Table 9-4 Resulting actions when the tgtoffline parameter is used

Status of target volume in z/OS	Permit FlashCopy to occur if target volume is online	Resulting action
Volume is online	Not selected	FlashCopy definition is not possible
Volume is online	Selected	FlashCopy definition is queued until target volume goes offline
Volume is offline	Selected or not selected	FlashCopy will be started immediately

- **tgtinhibit**: Inhibit writes to target volume

  If FlashCopy is active, writes to the target volume are not allowed (inhibited).

- **record**: change recording

  Activating the option *change recording* during setup of a FlashCopy enables subsequent refreshes to the target volume. To do so, a second bitmap is created for the source volume, which keeps track of all writes to the source. This bitmap can later be used to refresh the target by only copying the updates from the source to the target.

- **persist**: persistent FlashCopy

  The FlashCopy relationship will continue to exist until explicitly removed by an interface method. If this option is not selected, the FlashCopy relationship will exist until all data has been copied from the source volume to the target.

- **nocp**: full volume background copy

  With the parameter **nocp** it is possible to indicate whether the data of the source volume will be copied to the target volume in the background or not. If **-nocp** isn't used, a copy of all data from source to target takes place in the background. With **-nocp** selected only updates to the source volume will cause writes to the target volume—this way the time-zero data can be preserved.

- **seqnum**: sequence number for FlashCopy pairs

  A number that identifies the FlashCopy relationship. Once used with the initial **mkflash** command, it could be used within subsequent commands to refer to multiple FlashCopy relationships.

- **source:target**: identification of source volume and target volume

- **fast**: reverse FlashCopy before background copy finished

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Allows you to issue the **reverseflash** command before the background copy finished.

- **cp**: restrict command to FlashCopy relationships with background copy
- **sourceLSS**: reset Consistency Group for source logical subsystems
- **s**: display of FlashCopy pairs with **lsflash** command
  The shortened output of the **lsflash** command is returned. Only the FlashCopy pair IDs are displayed.
- **l**: display additional FlashCopy information

  The standard output of the **lsflash** command is enhanced. The values for the copy indicator, out of synch tracks, date created, and date synchronized are displayed.
- **activecp**: selection of FlashCopy pairs with active background copy
- **revertible**: selection of FlashCopy pairs with revertible attribute

9.4.2 Local FlashCopy commands - examples

This section explains the DS CLI commands that you can use to manage FlashCopy and also shows examples of their use.

Initiating FlashCopy using mkflash

With **mkflash,** a local FlashCopy can be established. Five coding examples for **mkflash** are shown in Example 9-1.

Example 9-1 mkflash command examples

```
Script
#--- script to establish FlashCopy relationships
#-------------------------------------------------------------
mkflash -dev IBM.1750-13ABC2A          -seqnum 00 0000:0100
Date/Time: July 8, 2005 10:31:59 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0000:0100 successfully created.

mkflash -dev IBM.1750-13ABC2A -freeze  -seqnum 01 0001:0101 0005:0105
Date/Time: July 8, 2005 10:32:26 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0001:0101 successfully created.
CMUC00137I mkflash: FlashCopy pair 0005:0105 successfully created.

mkflash -dev IBM.1750-13ABC2A -record  -seqnum 02 0002:0102
Date/Time: July 8, 2005 10:32:54 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0002:0102 successfully created.

mkflash -dev IBM.1750-13ABC2A -persist -seqnum 03 0003:0103
Date/Time: July 8, 2005 10:33:14 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0003:0103 successfully created.

mkflash -dev IBM.1750-13ABC2A -nocp    -seqnum 04 0004:0104
Date/Time: July 8, 2005 10:33:46 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0004:0104 successfully created.

Listing of the properties of the FlashCopies
lsflash -dev IBM.1750-13ABC2A 0000-0004
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
=========================================================================================================================================
0000:0100 00     0           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Enabled
0001:0101 00     1           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Enabled
0002:0102 00     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0003:0103 00     3           300     Disabled   Disabled  Enabled    Disabled   Disabled           Disabled           Enabled
0004:0104 00     4           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Disabled
```


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The following explanations apply to the cases presented in Example 9-1:

- **Example 1: 0000 → 0100**

  The FlashCopy between volume 0000 and volume 0100 is established with the property *BackgroundCopy* enabled. This is the default unless specified differently using the **-nocp** parameter. All other properties are disabled. The background copy takes place immediately. Once the copy is done, the FlashCopy relationship is automatically removed.

- **Example 2: 0001 → 0101 and 0005 → 0105**

  A FlashCopy is established between volumes 0001 and 0101 and between volumes 0005 and 0105. Both FlashCopy relationships have the same sequence number. A Consistency Group for the two FlashCopy relationships is created using the **freeze** parameter. *BackgroundCopy* is enabled—by default if not specified differently using the **-nocp** parameter. All other properties are disabled. The background copies take place immediately for both pairs of volumes, and once the copies are completed the FlashCopy relationships are automatically removed.

- **Example 3: 0002 → 0102**
  The FlashCopy between volume 0002 and volume 0102 is established with the following FlashCopy properties enabled: *Recording*, *Persistent*, and *BackgroundCopy*.

  Note: The parameter **-persist** is automatically added whenever **-record** is used.

  The background copy takes place immediately and the relationship remains as a persistent relationship. Using other DS CLI commands it could be reversed and/or resynchronized.

- **Example 4: 0003 → 0103**

  The FlashCopy between volume 0003 and volume 0103 is established with the following FlashCopy properties enabled: *Persistent* and *BackgroundCopy.* All other FlashCopy properties are disabled. The background copy takes place immediately. Once the background copy is finished the FlashCopy relationship will remain—because of the persistent flag.

- **Example 5: 0004 → 0104**
  The FlashCopy between volume 0004 and volume 0104 is established with all the FlashCopy options disabled. Due to the **-nocp** parameter, no full background copy will be done. Only the data changed in the source is copied to the target prior to changing it. Over time, this could result in the situation where all data is copied to the target —then the FlashCopy relationship would end. It would also end after a background copy is initiated using the DS SM. This way the relationship is temporarily persistent even though the property *Persistent* is not activated.

Display existing FlashCopy relationships using lsflash

The command **lsflash** can be used to display FlashCopy relationships and its properties. Parameters can be used with this command to identify the subset of FlashCopy relationships to be displayed.

Example 9-2 on page 77 shows a script with several **lsflash** commands and the output of the script (this script is logically based on the example for **mkflash**).

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Example 9-2 lsflash command examples

```
#--- Example 1
lsflash -dev IBM.1750-13ABC2A 0004
Date/Time: July 8, 2005 3:00:49 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0004:0104 00     4           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Disabled

#--- Example 2
lsflash -dev IBM.1750-13ABC2A 0000-0004
Date/Time: July 8, 2005 3:01:02 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0000:0100 00     0           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Enabled
0001:0101 00     1           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Enabled
0002:0102 00     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0003:0103 00     3           300     Disabled   Disabled  Enabled    Disabled   Disabled           Disabled           Enabled
0004:0104 00     4           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Disabled

#--- Example 3
lsflash -dev IBM.1750-13ABC2A -l 0000-0004
Date/Time: July 8, 2005 3:01:17 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
OutOfSyncTracks DateCreated                    DateSynced
==========================================================================================================================================
0000:0100 00     0           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Enabled
122051          Fri Jul 08 11:02:22 CEST 2005 Fri Jul 08 11:02:22 CEST 2005
0001:0101 00     1           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Enabled
150255          Fri Jul 08 11:02:35 CEST 2005 Fri Jul 08 11:02:35 CEST 2005
0002:0102 00     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
150255          Fri Jul 08 11:02:48 CEST 2005 Fri Jul 08 11:02:48 CEST 2005
0003:0103 00     3           300     Disabled   Disabled  Enabled    Disabled   Disabled           Disabled           Enabled
150255          Fri Jul 08 11:03:04 CEST 2005 Fri Jul 08 11:03:04 CEST 2005
0004:0104 00     4           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Disabled
150255          Fri Jul 08 11:03:17 CEST 2005 Fri Jul 08 11:03:17 CEST 2005

#--- Example 4
lsflash -dev IBM.1750-13ABC2A -s 0000-0001
Date/Time: July 8, 2005 3:01:36 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID
=========
0000:0100
0001:0101

#--- Example 5
lsflash -dev IBM.1750-13ABC2A -activecp 0000-0004
Date/Time: July 8, 2005 3:01:48 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMMCI9006E No FlashCopy instances named 0000-0004 found that match criteria: dev = IBM.1750-13ABC2A and activecp = true.

#--- Example 6
lsflash -dev IBM.1750-13ABC2A -record 0000-0004
Date/Time: July 8, 2005 3:02:05 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0002:0102 00     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled

#--- Example 7
lsflash -dev IBM.1750-13ABC2A -persist 0000-0004
Date/Time: July 8, 2005 3:02:17 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0002:0102 00     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0003:0103 00     3           300     Disabled   Disabled  Enabled    Disabled   Disabled           Disabled           Enabled

#--- Example 8
lsflash -dev IBM.1750-13ABC2A -revertible 0000-0004
Date/Time: July 8, 2005 3:02:29 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A

#--- Example 9
lsflash -dev IBM.1750-13ABC2A -cp 0000-0004
Date/Time: July 8, 2005 3:02:45 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
```


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```
==========================================================================================================================
0000:0100 00     0          300     Disabled   Disabled  Disabled   Disabled   Disabled          Disabled          Enabled
0001:0101 00     1          300     Disabled   Disabled  Disabled   Disabled   Disabled          Disabled          Enabled
0002:0102 00     2          300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled
0003:0103 00     3          300     Disabled   Disabled  Enabled    Disabled   Disabled          Disabled          Enabled
```

The following explanations apply to the cases presented in Example 9-2:

- Example 1: list FlashCopy information for a specific volume

  In this example, the **lsflash** command shows the FlashCopy relationship information for volume 0004, showing the status (enabled/disabled) of the FlashCopy properties.

- Example 2: list existing FlashCopy relationships information within a range of volumes.

  In this example, the **lsflash** command shows the FlashCopy relationships information for the range of volumes 0000 to 0004, showing the properties status (enabled/disabled).

- Example 3: list existing FlashCopy relationships with full information.

  Using the **-l** parameter with the **lsflash** command displays the default output plus information on the following properties: OutOfSyncTracks, DateCreated, and DateSynced.

- Example 4: list IDs of existing FlashCopy pairs within a volume range.

  Using the **-s** parameter displays only the FlashCopy source and target volume IDs for the specified range of volumes.

- Example 5: list FlashCopy relationships with active background copy running.

  Using the parameter **-activecp** will display only those FlashCopy relationships within the selected range of volumes for which a background copy is actively running. The output format is the default output. In our example there were no active background copies.

- Example 6: list existing FlashCopy relationships with **-record** enabled.

  Using the **-record** parameter will display only those FlashCopy relationships within the selected range of volumes that were established with the **-record** parameter.

- Example 7: list existing FlashCopy relationships with the *Persistent* attribute enabled.

  When using the parameter **-persist** only those FlashCopy relationships within the range of selected volumes for which the *Persistent* option is enabled will be displayed.

- Example 8: list existing FlashCopy relationships which are revertible.

  When using the parameter **-revertible** only those FlashCopy relationships within the range of selected volumes for which the option *Revertible* is enabled will be displayed. There were no revertible relationships in our example.

- Example 9: list existing FlashCopy relationships for which BackgroundCopy is enabled.

  When using the parameter **-cp** only those FlashCopy relationships within the range of selected volumes for which the option *BackgroundCopy* is enabled will be displayed.

Set an existing FlashCopy to revertible using setflashrevertible

The command **setflashrevertible** can be used to modify the *revertible* attribute of a FlashCopy relationship that is part of a Global Mirror relationship.

The FlashCopy options *Recording* and *Persistent* must be enabled to set a FlashCopy relationship to revertible using this command. This command needs to be executed prior to running a **commitflash** or **revertflash**.

Example 9-3 on page 79 illustrates two situations using the **setflashrevertible** command.

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Example 9-3 setflashrevertible command examples

```
#-------------------------------------------------------------
#--- script to set FlashCopy property Revertible to value enabled and display values afterwards
#-------------------------------------------------------------
#--- Example 1
setflashrevertible -dev IBM.1750-13ABC2A 0002:0102
Date/Time: July 8, 2005 6:52:49 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00167I setflashrevertible: FlashCopy volume pair 0002:0102 successfully made revertible.
lsflash -dev IBM.1750-13ABC2A 0000-0004
Date/Time: July 8, 2005 7:15:30 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID       SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================
0002:0102 00     0          300     Disabled   Enabled   Enabled    Enabled    Enabled           Disabled          Enabled

#--- Example 2
setflashrevertible -dev IBM.1750-13ABC2A 0003:0103
Date/Time: July 8, 2005 6:53:16 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUN03027E setflashrevertible: 0003:0103: FlashCopy operation failure: action prohibited by current FlashCopy state
```

The following explanations apply to the cases presented in Example 9-3:

- Example 1: set the FlashCopy relationship to *Revertible*.

  This command will set the existing FlashCopy for source volume 0002 and target volume 0102 to revertible. Once the property *Revertible* is enabled, any subsequent commands will result in an error message similar to the one displayed in Example 2.

- Example 2: error occurs when trying to set FlashCopy relationship to revertible.

  When trying to set a FlashCopy relationship to *Revertible* for which the property *Recording* is disabled, an error will result. The script will end after this command with return code 2 and any other commands following the one that caused the error will not be executed.

Commit data to target using commitflash

The command **commitflash** can be used to commit data to a target volume to set consistency between source and target. It is intended to be used in asynchronous remote copy environments such as Global Mirror. Therefore, its usage is discussed in greater detail in Part 6, “Global Mirror” on page 265, while this section discusses the basic use of the command.

Before the FlashCopy relationship can be committed, it needs to be made revertible. Typically, this is done automatically by an application such as Global Mirror. However, it can also be set manually.

Example 9-4 Commit command examples

```
#--- Example 1
lsflash -dev IBM.1750-13ABC2A 0000-0005
Date/Time: July 10, 2005 2:45:28 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID       SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================
0001:0101 00     1          300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled
0005:0105 00     1          300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled
setflashrevertible -dev IBM.1750-13ABC2A -seqnum 01 0001:0101 0005:0105
Date/Time: July 10, 2005 2:45:40 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00167I setflashrevertible: FlashCopy volume pair 0001:0101 successfully made revertible.
CMUC00167I setflashrevertible: FlashCopy volume pair 0005:0105 successfully made revertible.
lsflash -dev IBM.1750-13ABC2A 0000-0005
Date/Time: July 10, 2005 2:46:07 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID       SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================
0001:0101 00     1          300     Disabled   Enabled   Enabled    Enabled    Enabled           Disabled          Enabled
0005:0105 00     1          300     Disabled   Enabled   Enabled    Enabled    Enabled           Disabled          Enabled
```


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```
commitflash -dev IBM.1750-13ABC2A 0001-0005
Date/Time: July 10, 2005 2:46:18 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00170I commitflash: FlashCopy volume pair 0001:0001 successfully committed.
CMUC00170I commitflash: FlashCopy volume pair 0005:0005 successfully committed.
lsflash -dev IBM.1750-13ABC2A -l 0000-0005
Date/Time: July 10, 2005 2:46:47 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0001:0101 00     1           300     Disabled   Enabled   Enabled    Disabled   Disabled          Enabled           Disabled
0005:0105 00     1           300     Disabled   Enabled   Enabled    Disabled   Disabled          Enabled           Disabled

#--- Example 2
commitflash -dev IBM.1750-13ABC2A 0003:0103
CMUN03027E commitflash: 0003:0003: FlashCopy operation failure: action prohibited by current FlashCopy state
```

The following explanations apply to the cases presented in Example 9-4:

- Example 1: commit the FlashCopy relationship.

  This example shows the properties of the two FlashCopy relationships 0001:0101 and 0005:0105 using the **lsflash** command prior and after issuing the **setflashrevertible** command. After the **commitflash** command is executed the properties of the two FlashCopy relationships are listed again.

- Example 2: error occurs when trying to commit FlashCopy relationship.

  When trying to commit a FlashCopy relationship that isn't revertible (property *Revertible* is disabled) an error will be the result. The script will end after this command with return code 2 and any other commands following the one that causes the error will not be executed.

Incremental FlashCopy using resyncflash

With the **resyncflash** command an existing FlashCopy relationship can be incremented. To run this command, the FlashCopy relationship must have the options *Recording* and *Persistent* enabled.

Tip: You do not have to wait for the background copy to complete before you do the FlashCopy resynchronization. The **resyncflash** command can be used at any time.

To make sure an existing FlashCopy relationship can be incremented multiple times, it is necessary to repeat the **-record** and **-persist** parameters with the **resyncflash** command.

Example 9-5 shows examples where the **resyncflash** command is used.

Example 9-5 resyncflash command examples

```
#--- Example 1
mkflash -dev IBM.1750-13ABC2A -record -persist -seqnum 01 0001:0101 0005:0105
Date/Time: July 10, 2005 5:04:48 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0001:0101 successfully created.
CMUC00137I mkflash: FlashCopy pair 0005:0105 successfully created.
resyncflash -dev IBM.1750-13ABC2A -seqnum 13 0003:0103
Date/Time: July 10, 2005 5:05:18 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0003:0103 successfully created.
lsflash -dev IBM.1750-13ABC2A 0000-0005
Date/Time: July 10, 2005 5:05:45 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0001:0101 00     1           300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled
0003:0103 00     3           300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled
0005:0105 00     1           300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled
```


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```
resyncflash -dev IBM.1750-13ABC2A -record -persist -seqnum 11 0001:0101 0005:0105
Date/Time: July 10, 2005 5:05:58 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00168I resyncflash: FlashCopy volume pair 0001:0101 successfully resynchronized.
CMUC00168I resyncflash: FlashCopy volume pair 0005:0105 successfully resynchronized.
resyncflash -dev IBM.1750-13ABC2A seqnum 13 0003:0103
Date/Time: July 10, 2005 5:06:25 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00168I resyncflash: FlashCopy volume pair 0003:0103 successfully resynchronized.
lsflash -dev IBM.1750-13ABC2A 0000-0005
Date/Time: July 10, 2005 5:06:39 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0001:0101 00     11          300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled
0003:0103 00     13          300     Disabled   Disabled  Disabled   Disabled   Disabled          Disabled          Enabled
0005:0105 00     11          300     Disabled   Enabled   Enabled    Disabled   Disabled          Disabled          Enabled

#--- Example 2
mkflash -dev IBM.1750-13ABC2A -seqnum 03 0004:0104
Date/Time: July 10, 2005 5:05:32 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0004:0104 successfully created.

lsflash -dev IBM.1750-13ABC2A 0004
Date/Time: July 10, 2005 5:06:39 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0004:0104 00     4           300     Disabled   Disabled  Disabled   Disabled   Disabled          Disabled          Enabled

resyncflash -dev IBM.1750-13ABC2A -record -persist -seqnum 14 0004:0104
Date/Time: July 10, 2005 5:06:51 PM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUN03027E resyncflash: 0004:0104: FlashCopy operation failure: action prohibited by current FlashCopy state
```

The following explanations apply to the examples shown in Example 9-5:

- Example 1: increment a FlashCopy relationship.

  In this example, three FlashCopy relationships are created with the **-record** and **-persist** parameters. The **resyncflash** commands are executed using a different sequence number, which overwrites the one of the current FlashCopy relationship. The sequence number only changes if the **resyncflash** finishes successfully.

  The **resyncflash** for the 0001:0101 and 0005:0105 relationships take place using the **-record** and **-persist** parameters. Because the two parameters are omitted for the 0003:0103 FlashCopy relationship, the two properties *Recording* and *Persistent* change to disabled for this FlashCopy relationship. As soon as the background copy for the 0003:0103 FlashCopy relationship finishes, the FlashCopy relationship terminates.

- Example 2: error occurs when trying to increment FlashCopy relationship.

  When trying to increment a FlashCopy relationship for which the properties *Recording* and *Persistent* are disabled, an error will be the result. The script will end after this command with return code 2 and any other commands following the one that caused the error will not be executed.

Reverse source-target relationship using reverseflash

The command **reverseflash** can be used to change the direction of a FlashCopy relationship. The former source becomes target and the former target becomes source. The data is copied from the target to the source.

Example 9-6 on page 82 illustrates examples of the use of the **reverseflash** command.

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Example 9-6 reverseflash command examples

```
#--- Example 1
lsflash -dev IBM.1750-13ABC2A 0000-0005
Date/Time: July 11, 2005 5:08:49 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID       SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0001:0101 00     1           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0002:0102 00     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0003:0103 00     3           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0005:0105 00     1           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
reverseflash -dev IBM.1750-13ABC2A -record -persist 0001:0101 0005:0105
Date/Time: July 11, 2005 5:09:14 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00169I reverseflash: FlashCopy volume pair 0001:0101 successfully reversed.
CMUC00169I reverseflash: FlashCopy volume pair 0005:0105 successfully reversed.
reverseflash -dev IBM.1750-13ABC2A -record 0002:0102
Date/Time: July 11, 2005 5:09:28 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00169I reverseflash: FlashCopy volume pair 0002:0102 successfully reversed.
reverseflash -dev IBM.1750-13ABC2A 0003:0103
Date/Time: July 11, 2005 5:09:42 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00169I reverseflash: FlashCopy volume pair 0003:0103 successfully reversed.
lsflash -dev IBM.1750-13ABC2A 0000-0005
Date/Time: July 11, 2005 5:09:55 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID       SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0101:0001 01     1           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0102:0002 01     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0105:0005 01     1           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled

#--- Example 2
reverseflash -dev IBM.1750-13ABC2A -record 0002:0102
Date/Time: July 11, 2005 6:16:12 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00169I reverseflash: FlashCopy volume pair 0002:0102 successfully reversed.
lsflash -dev IBM.1750-13ABC2A 0002
Date/Time: July 11, 2005 6:16:27 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID       SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0102:0002 01     2           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled

#--- Example 3
reverseflash -dev IBM.1750-13ABC2A -seqnum 12 -record 0102:0002
Date/Time: July 11, 2005 6:28:32 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00169I reverseflash: FlashCopy volume pair 0102:0002 successfully reversed.
lsflash -dev IBM.1750-13ABC2A 0002
Date/Time: July 11, 2005 6:28:46 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID       SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0002:0102 00     12          300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
```

The following explanations apply to the examples shown in Example 9-6:

- Example 1: reverse a FlashCopy relationship.

  In this example, three FlashCopy relationships are created with the **-record** and **-persist** parameters. The **reverseflash** commands are executed using a different sequence number, which overwrites the one of the current FlashCopy relationship.

  The **reverseflash** for the 0001:0101 and 0005:0105 relationships take place using the **-record** and **-persist** parameters. Because the two parameters are omitted for the 0003:0103 FlashCopy relationship, the two properties *Recording* and *Persistent* change to disabled for this FlashCopy relationship. This terminates the 0003:0103 FlashCopy relationship as soon it is successfully reversed.

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- Example 2: reverse a FlashCopy relationship multiple times.

  It is possible to reverse a FlashCopy relationship multiple times, thus recopying the contents of the original FlashCopy target volume multiple times back to the original source volume. In this example the 0002:0102 was reversed once as part of example 1. Then changes are made to data residing on volume 0002. A subsequent **reverseflash** for 0002:0102 eliminates the changes made to 0002 and brings back the data from volume 0102 to volume 0002 as it was during the initial FlashCopy.

- Example 3: reestablish original FlashCopy direction, reversing again.

  It is possible to reverse a FlashCopy relationship back again. In Example 3 this is shown for the reversed FlashCopy relationship 0102:0002. Reversing it a second time and referring to it as FlashCopy pair 0102:0002 is similar to establishing a new FlashCopy for the volume pair 0002:0102. In this case a sequence number provided with the **reverseflash** is used to identify a new FlashCopy relationship.

Reset target to contents of last consistency point using revertflash

The command **revertflash** can be used to reset the target volume to the contents of the last consistency point. Like the **commitflash** command, this command is intended to be used in asynchronous environments like Global Mirror environments. Before this command can be issued, the relationship must be made revertible, either automatically as with Global Mirror, or manually using the **setrevertible** command. See Example 9-7.

Example 9-7 revertflash command example

```
#--- Example 1
mkflash -dev IBM.1750-13ABC2A -record -persist  -seqnum 01 0001:0101
Date/Time: July 11, 2005 9:44:27 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0001:0101 successfully created.
mkflash -dev IBM.1750-13ABC2A -nocp -seqnum 04 0001:0104 0001:0105
Date/Time: July 11, 2005 9:44:42 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00137I mkflash: FlashCopy pair 0001:0104 successfully created.
CMUC00137I mkflash: FlashCopy pair 0001:0105 successfully created.
lsflash -dev IBM.1750-13ABC2A 0000-0005
Date/Time: July 11, 2005 9:44:56 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
==========================================================================================================================================
0001:0101 00     1           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled           Enabled
0001:0104 00     4           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Disabled
0001:0105 00     4           300     Disabled   Disabled  Disabled   Disabled   Disabled           Disabled           Disabled

setflashrevertible -dev IBM.1750-13ABC2A 0001:0101
Date/Time: July 11, 2005 10:14:33 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00167I setflashrevertible: FlashCopy volume pair 0001:0101 successfully made revertible.

revertflash -dev IBM.1750-13ABC2A 0001
Date/Time: July 11, 2005 10:14:47 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00171I revertflash: FlashCopy volume pair 0001:0001 successfully reverted.
```

In Example 9-7, three FlashCopy relationships are created for one source volume: 0001:0101, 0001:0104 and 0105. The **revertflash** command is executed for source 0001 and as the FlashCopy relationship 0001:0101 has the *Recording* and *Persistent* property enabled, this command refers to this FlashCopy relationship 0001:0101. Any updates done to volume 0101 will be overwritten.

Run new background copy for persistent FlashCopy using rmflash

Additional background copies for persistent FlashCopy relationships can be created using the **rmflash** command in combination with its **-cp** parameter. See Example 9-8 on page 84.

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Example 9-8 rmflash command to create new background copy

```
#--- Example 1
rmflash -dev IBM.1750-13ABC2A -quiet -cp 0001:0101
Date/Time: July 11, 2005 11:21:05 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00143I rmflash: Background copy process for FlashCopy pair 0001:0101 successfully started. The persistent relationship will not be
removed
```

In the example presented in Example 9-8, create new background copy of a persistent FlashCopy relationship, the existing FlashCopy relationship 0001:0101 is used to create a new background copy.

Remove local FlashCopy using rmflash

The command **rmflash** can be used to remove a FlashCopy relationship. Unlike other commands, it doesn't return an error if the request runs for a FlashCopy relationship that doesn't exist.

In scripts it should always be used with the **-quiet** parameter to avoid the confirmation prompt. See Example 9-9.

Example 9-9 rmflash command example

```
#--- Example 1
rmflash -dev IBM.1750-13ABC2A -quiet 0001:0101
Date/Time: July 11, 2005 11:21:39 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13ABC2A
CMUC00140I rmflash: FlashCopy pair 0001:0101 successfully removed.
```

In Example 9-9, the existing FlashCopy relationship **0001:0101** is removed.

9.4.3 FlashCopy Consistency Groups

Typically, large applications such as databases have their data spread across several volumes. In order to create a consistent copy or backup, a FlashCopy of all the volumes should be done at exactly the same point-in-time. FlashCopy Consistency Groups are designed to achieve this exact purpose.

Creating FlashCopy Consistency Groups using mkflash

Use the **mkflash** command with the **-freeze** parameter to create a FlashCopy Consistency Group. This command causes the DS6000 to briefly prevent I/O to the volumes in the Consistency Group. During this time, any I/O that comes from the host will be returned with a long busy error, which the host bus adapter will automatically retry. However, if the I/O is frozen for an extended period of time, there will be application errors on the host. For this reason, the Consistency Group should be unfrozen as quickly as possible.

Example 9-10 illustrates the creation of a FlashCopy Consistency Group that contains two FlashCopy pairs.

Example 9-10 Creating FlashCopy Consistency Groups

```
dscli> mkflash -dev IBM.1750-7506571 -freeze 1500-1501:1502-1503
Date/Time: October 24, 2005 3:37:49 AM PDT IBM DSCLI Version: 5.0.5.6 DS: IBM.1750-7506571
CMUC00137I mkflash: FlashCopy pair 1500:1502 successfully created.
CMUC00137I mkflash: FlashCopy pair 1501:1503 successfully created.
```


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Reset FlashCopy Consistency Group using unfreezeflash

The command **unfreezeflash** can be used to remove a Consistency Group for multiple volumes for which FlashCopy relations were established using the **-freeze** parameter. This command removes the long busy condition and allows I/Os to continue for the source volumes. See Example 9-11.

The **unfreezeflash** command is issued to the entire logical subsystem (LSS).

Example 9-11 unfreezeflash command example

```
#--- Example 1
unfreezeflash -dev IBM.1750-7506571/00
Date/Time: July 12, 2005 12:27:06 AM CEST IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-7506571
CMUC00172I unfreezeflash: FlashCopy consistency group for logical subsystem 00: successfully reset.
```

9.5 Remote FlashCopy using the DS CLI

Remote FlashCopy commands are similar to local FlashCopy commands. The remote commands can be issued whenever a DS6000 mirroring takes place from one DS6000 to another DS6000. In this situation the Fibre Channel links between the two DS6000s—that are used for mirroring purposes—are also used to transmit the FlashCopy commands to the remote DS6000. For detailed information about the DS CLI, refer to *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922.

9.5.1 Remote FlashCopy commands

Table 9-5 Command names for local and remote FlashCopy

Local Command	Remote Command	Remark
mkflash	mkremoteflash	Establish FlashCopy
lsflash	lsremoteflash	List FlashCopy
setflashrevertible	setremoteflashrevertible	Set FlashCopy to revertible
commitflash	commitremoteflash	Commit FlashCopy on target
resyncflash	resyncremoteflash	Increment FlashCopy
reverseflash	reverseremoteflash	Switch source-target
revertflash	revertremoteflash	Reset to last consistency point
unfreezeflash	-	Reset Consistency Group
rmflash	rmremoteflash	Remove FlashCopy

The syntax of the remote FlashCopy commands is similar to the syntax of the local FlashCopy commands. The commands themselves have similar names except for the "**remote**" character string that you can see in the remote FlashCopy commands names.

Table 9-5 shows the similarity between both sets of commands; their actions are also similar.

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9.5.2 Parameters used in remote FlashCopy commands

Parameters	DS CLI Commands							
	mkremote flash	lsremote flash	setremote flash revertible	commit remote flash	resync remote flash	reverse remote flash	revert remote flash	rmflash
Source								
freeze	x				x			
Target								
tgtpprc	x				x	x		
tgtoffline	x		x		x	x		
tgtinhibit	x				x	x		
tgtonly								x
Flashcopy pair								
dev	x	x	x	x	x	x	x	x
record	x	x			x	x		
persist	x	x			x	x		
nocp	x							
seqnum	x	x	x	x	x	x	x	x
source:target	x	x			x			x
fast						x		
source				x			x	
cp		x						x
source LSS								
l		x						
s		x						
activecp		x						
revertible		x						
Command								
conduit	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
quiet								x

Figure 9-2 DS CLI remote FlashCopy commands and parameters

Most of the parameters for remote FlashCopy commands are similar to those for local FlashCopy commands. Two major exceptions between local and remote FlashCopy commands are:

- Each remote command has the parameter **`conduit`** to identify the link to pass the command to the secondary DS6000.
- The local FlashCopy command **`unfreezeflash`** has no remote equivalent.

Figure 9-2 summarizes the parameters and the corresponding DS CLI commands that can be used when doing remote FlashCopy.

The description of the parameters is similar to the description presented in Section 9.4.1, “Parameters used with local FlashCopy commands” on page 73. With regard to the parameter **`conduit`**, which only applies to remote FlashCopy, the following explanation applies:

`conduit`: within a remote mirror environment, the FlashCopy commands are sent across the mirror paths, thus avoiding the necessity of having separate network connections to the remote site solely for the management of the remote FlashCopy. The **`-conduit`** parameter identifies the path to be used for transmitting the commands to the remote site.

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9.6 FlashCopy management using the DS SM

To use the DS SM front end GUI, a supported Web Browser needs to be installed on the workstation. The DS SM communicates with the DS SMC.

To start using the DS SM, enter in your Web browser the IP address of the DS SMC, as shown in Example 9-12. The password is set up by the administrator and needs to be changed during the first use of the DS SM.

Example 9-12 Starting DS SM

```
https://<ip-address>:8452/DS6000

The port 8452 is currently used to communicate with the DS SMC. This might change with new
releases. Always check with your Storage Administrator.
```

9.6.1 Initiate FlashCopy using Create

After you log in to the DS SM, select **Real-time manager** on the left, then **FlashCopy**. Identify the DS6000 for which you would like to initiate a FlashCopy. From the **Select Action** box, select **Create**. See Figure 9-3.

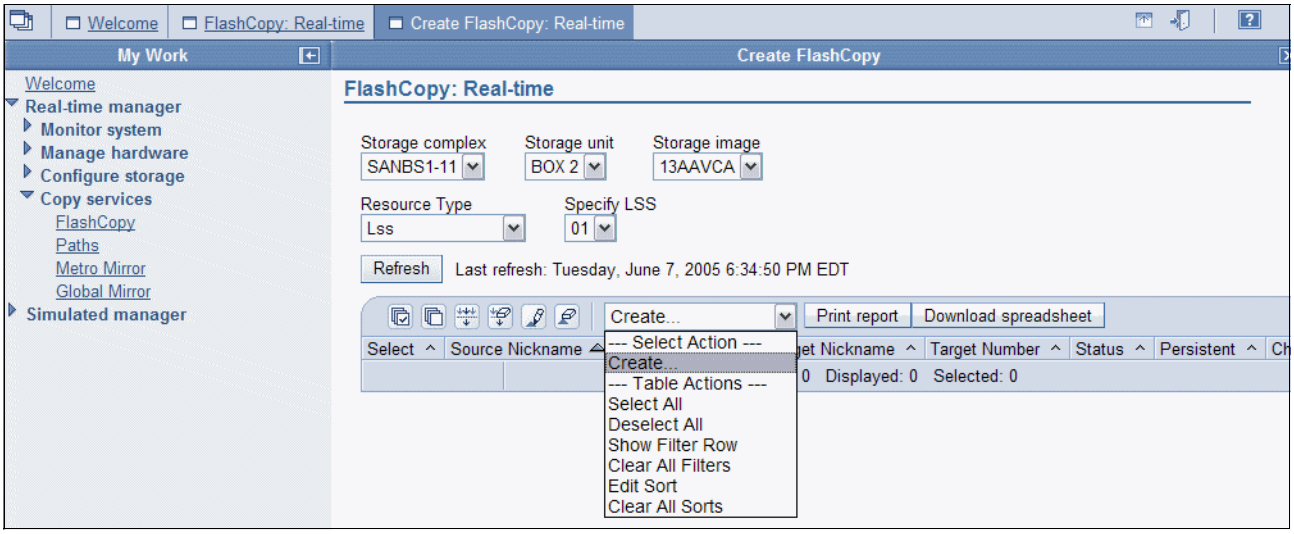

Figure 9-3 FlashCopy Create with DS SM

This selection will give you several windows, one after the other, to define the options that will be used with this FlashCopy.

1. Define relationship type.

   Select **A single source with a single target,** or **A single source with multiple targets** (if you want to allow Multiple Relationship FlashCopy).

2. Select source volumes

   Select one or multiple source volumes by checking the box at the left of the volume identification. For each of the source volumes, you will afterwards be presented with a window to select one or more targets.

3. Select target volumes

   Select the target volumes (you can't have more than 12 target volumes).

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4. Select common options

   Figure 9-4 on page 88 shows the options that can be chosen. The data provided in this window will be used for all defined FlashCopy pairs.

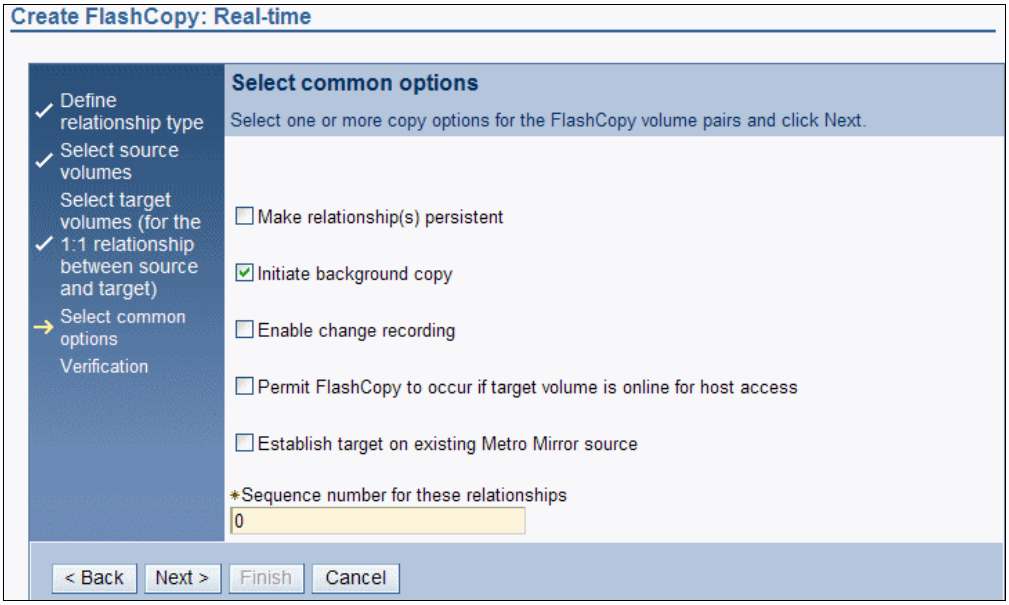
Create FlashCopy: Real-time
Define relationship type
Select source volumes
Select target volumes (for the 1:1 relationship between source and target)
Select common options
Verification
Select common options
Select one or more copy options for the FlashCopy volume pairs and click Next.
Make relationship(s) persistent
Initiate background copy
Enable change recording
Permit FlashCopy to occur if target volume is online for host access
Establish target on existing Metro Mirror source
*Sequence number for these relationships
0
< Back
Next >
Finish
Cancel

Figure 9-4 FlashCopy options

5. Verification.

   In the following verification window, all information regarding the FlashCopy definition is displayed. If it isn't possible to establish the FlashCopy relationship (if, for example, a volume was requested to be offline but it is not offline) then an information message is displayed on this window.

Comparing parameters for initial FlashCopy using DS SM and DS CLI

A FlashCopy can be defined by using the DS SM with a browser (selecting the **Create** for FlashCopy) or by using the DS CLI (using the **`mkflash`** command).

Using the DS SM, it is possible to define FlashCopies that will be generated immediately. It is currently not possible to store any FlashCopy tasks using the DS SM.

Table 9-6 shows the corresponding parameters for the various FlashCopy options when using the DS CLI command **`mkflash`** and the DS SM FlashCopy **Create** selection.

Table 9-6 Comparison of options/parameters used for FlashCopy DS CLI and DS SM

Options	Parameter with DS CLI command mkflash	Parameter with DS SM FlashCopy create	**Remark**
Options for the source volume			
Multiple relationship FlashCopy	List of source:target volumes	Multiple target volumes can be selected during create	
Consistency Groups for FlashCopy	Freeze	-	Not supported with the DS SM

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Options	Parameter with DS CLI command mkflash	Parameter with DS SM FlashCopy create	Remark
Options for the target volume			
FlashCopy target can be Metro Mirror or Global Copy primary	tgtpprc	Establish target on existing Metro Mirror source	
Permit target volume to be online in z/OS environment	tgtoffline	Permit FlashCopy to occur if target is online for host access	Only for CKD volumes (z/OS)
Inhibit writes to target volume	tgtinhibit	-	Resync target for z/OS
Options for FlashCopy pair			
Identification of FlashCopy pair	dev or source:target	Selected in windows	
Change Recording	record	Enable change recording	
Persistent FlashCopy	persist	Make relationship persistent	
Full volume background FlashCopy	nocp	Initiate background copy	
Sequence number	seqnum	Sequence number for this relationship	

9.6.2 Display properties of existing FlashCopy

On the DS SM window, select **Real-time manager** on the left, then **FlashCopy**. Identify the DS6000 (storage unit and LSS for example) for which you would like to display FlashCopy information. This will give you a list of all active FlashCopy relationships; see Figure 9-5.

By checking the box at the left of the FlashCopy of your interest, the Select Actions for this FlashCopy relationship are changed, based on the attributes of the FlashCopy relationship and the possible actions to be performed on it. Using the **Select Action**, select **Properties**. All attributes of the selected FlashCopy will be displayed.

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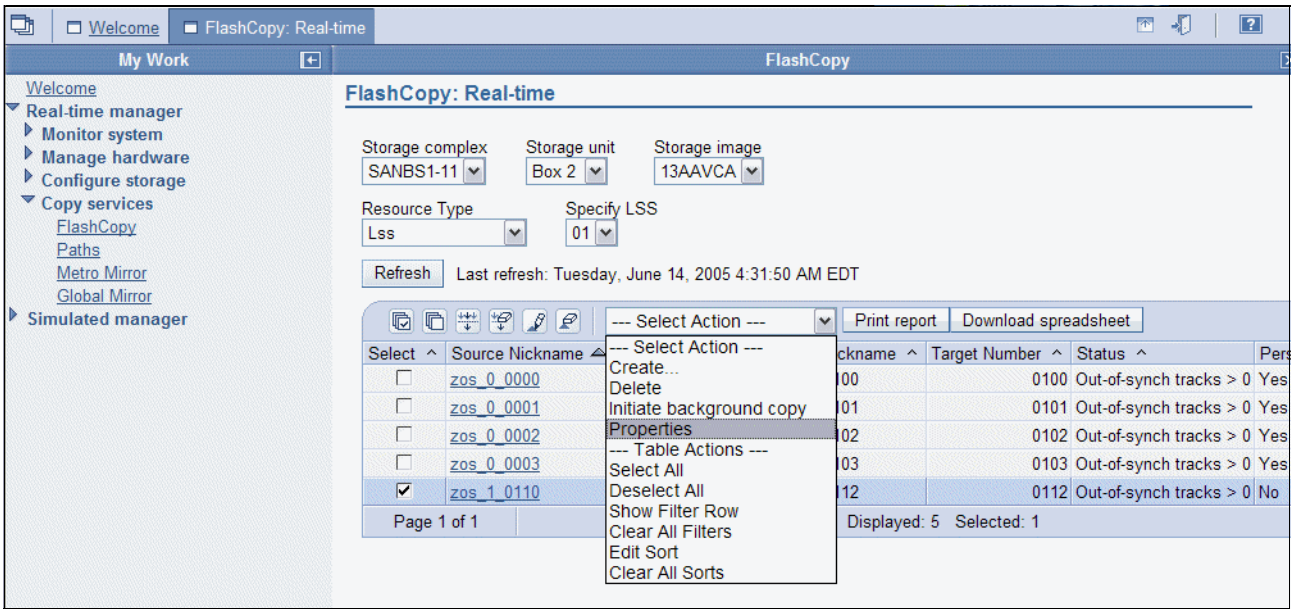

Figure 9-5 FlashCopy display properties

Note: In case you are selecting multiple FlashCopy relationships, the **Select Action** → **Properties** *will not* be presented. Select only one FlashCopy relationship to view its properties.

This selection will give you a window, with two folders:

- **General**

  In this folder all properties of the selected FlashCopy are presented. See Figure 9-6.

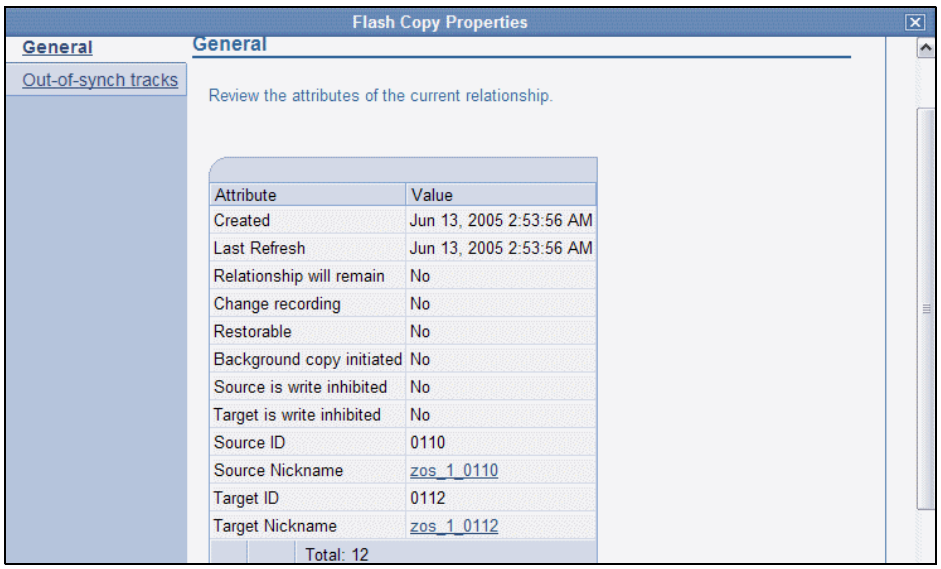

Figure 9-6 General folder with FlashCopy information

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- Out-of-synch tracks

  The window displaying the out-of-synch tracks can be used to monitor how the FlashCopy performs in the background; see Figure 9-7. A refresh interval can be set to refresh the display after a preselected period of time.

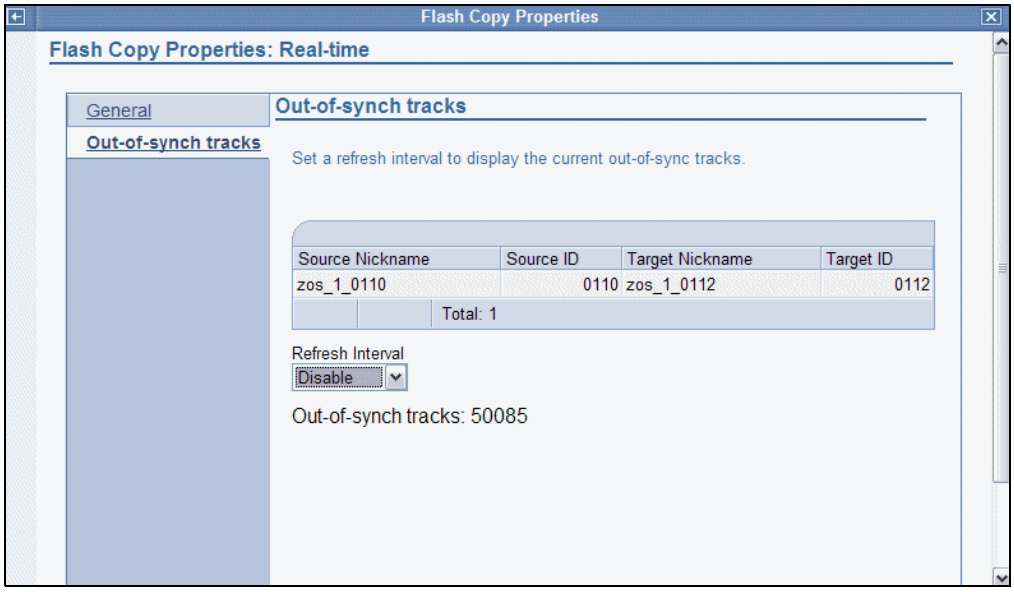

Figure 9-7 Out-of-synch tracks folder

Properties display - DS CLI vs. DS SM

Table 9-7 compares the differences in the way that the FlashCopy information is displayed when requested either using the DS CLI command **`lsflash`**, or an existing FlashCopy relationship was selected for display using the DS SM front end.

Table 9-7 FlashCopy properties as displayed by the DS CLI vs. the DS SM front end

Properties with DS CLI command *lsflash*		**Properties with DS SM** *FlashCopy property*	
Property	**Contents**	**Property**	**Contents**
Source LSS			
SrcLSS	#	Source LSS in selection window	From selection list
Sequence Number the FlashCopy belongs to. Can also be used for Consistency Groups.			
SequenceNum	###	Sequence number from overview window	###
Shows if a Background Copy is currently running. If the DS CLI returns ActiveCopy=disabled this could be similar to out-of-sync tracks>0 or copy complete on the DS SM.			
ActiveCopy	Enabled or disabled	Status in overview window	Copy complete or out-of-sync tracks>0 or background copy running
Shows if recording was selected for both source and target volume to allow for later usage of resync.			
Recording	Enabled or disabled	Change recording	Yes or no
Shows if the FlashCopy is a persistent one.			

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Properties with DS CLI command *lsflash*		**Properties with DS SM** *FlashCopy property*	
Persistent	Enabled or disabled	Relationship will remain	Yes or no
Identifies if the FlashCopy relationship can be changed by copying the contents of the target volume to the source volume			
Revertible	Enabled or disabled	Restorable	Yes or no
Identifies if the source can be used to write on it			
SourceWriteEnabled	Enabled or disabled	Source is write inhibited	Yes or no
Identifies it the target can be used by another server to write on it in parallel to the FlashCopy taking place			
TargetWriteEnabled	Enabled or disabled	Target is write inhibited	Yes or no
Identifies if a background copy was already done			
BackgroundCopy	Enabled or disabled	Background copy initiated	Yes or no
using -l parameter with DS CLI			
OutOfSyncTracks	A number		A number
DateCreated	Date	Created	Date
DateSynced	Date	Last refresh	Date

9.6.3 Reverse existing FlashCopy

To reverse an existing FlashCopy relationship you first display the list of active FlashCopy relationships as described in 9.6.2, “Display properties of existing FlashCopy” on page 89.

Then by checking the box at the left of the FlashCopy of your interest, the available **Select Actions** for this FlashCopy relationship will be shown. If the existing FlashCopy relationship can be reversed, it is possible to choose the **Select Action**, and then select **Reverse relationship**.

The next window displayed is shown in Figure 9-8. It displays those properties of the existing FlashCopy that might be changed during the reverse process. Changing the values of the parameters and then clicking **OK** will start the reverse process for the FlashCopy.

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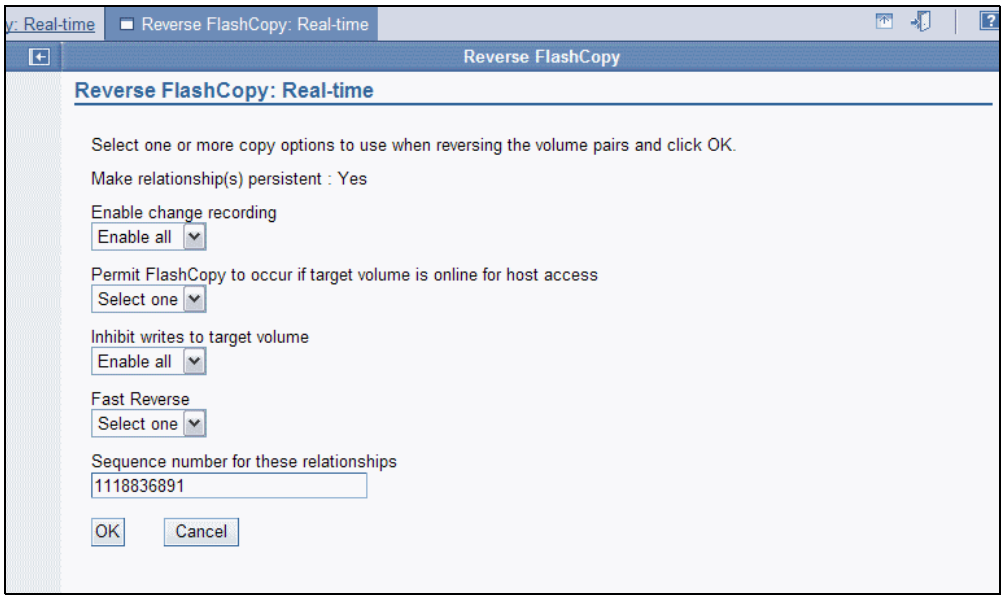

Figure 9-8 Properties that can be changed with the reverse action

9.6.4 Initiate background copy for a persistent FlashCopy relationship

To initiate a background copy for a persistent relationship, start on the DS SM front end window and select **Real Time Manage**r on the left, then **FlashCopy**. Identify the DS6000 (Storage Unit and LSS, for example) for which you would like to increment a FlashCopy. This will give you a list of all active FlashCopy relationships similar to Figure 9-9 on page 94.

By checking the box at the left of the FlashCopy relationship of your interest, the available **Select Actions** for this FlashCopy relationship will be shown. Then select **Initiate background copy**.

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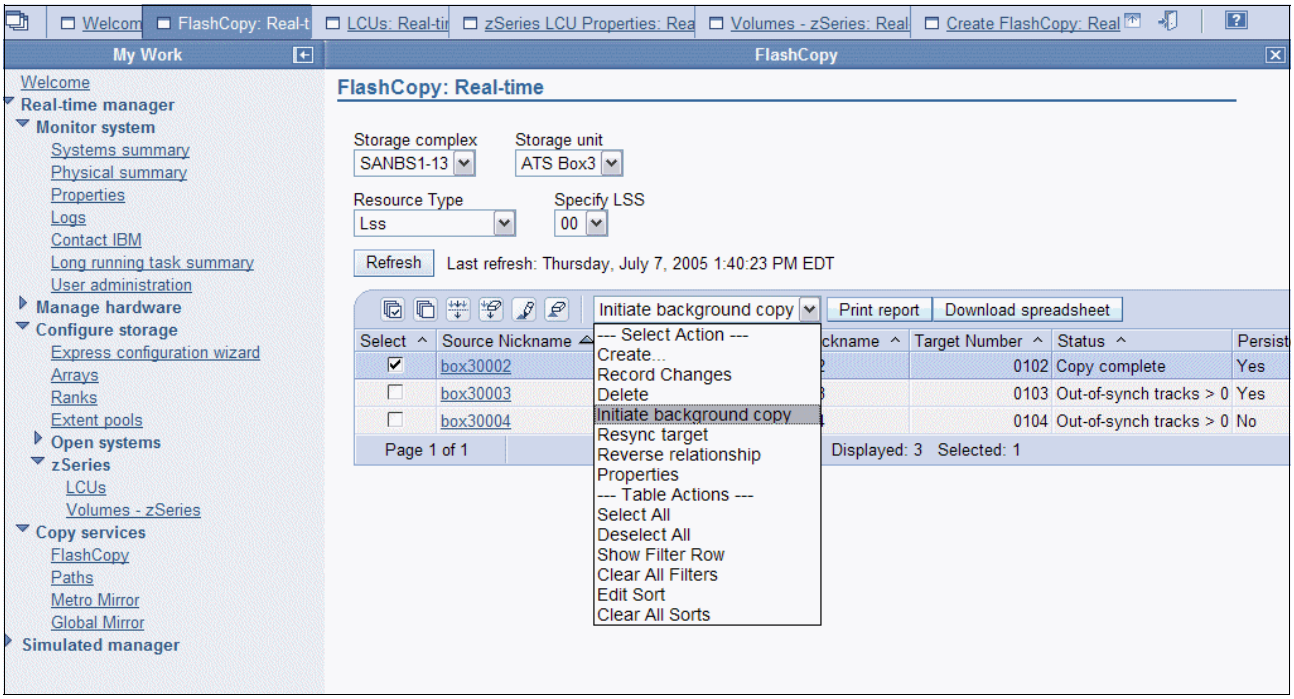

Figure 9-9 Initiate background copy

The next window displayed is shown in Figure 9-10. It prompts for the FlashCopy pairs for which the FlashCopy should run.

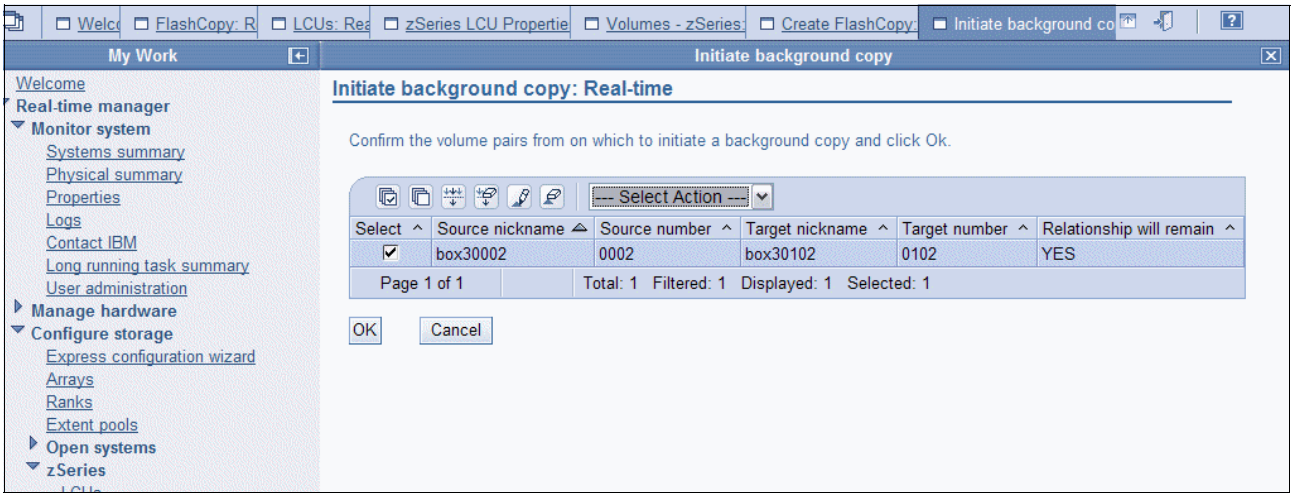

Figure 9-10 Prompt window for background copy

9.6.5 Resynchronize target

To resynchronize a target volume, start by displaying the list of active FlashCopy relationships as shown in Figure 9-11 on page 95. Then check the box at the left of the FlashCopy you want to resynchronize. Doing so, the available **Select Actions** for this FlashCopy relationship will be shown. Then select **Resync target**.

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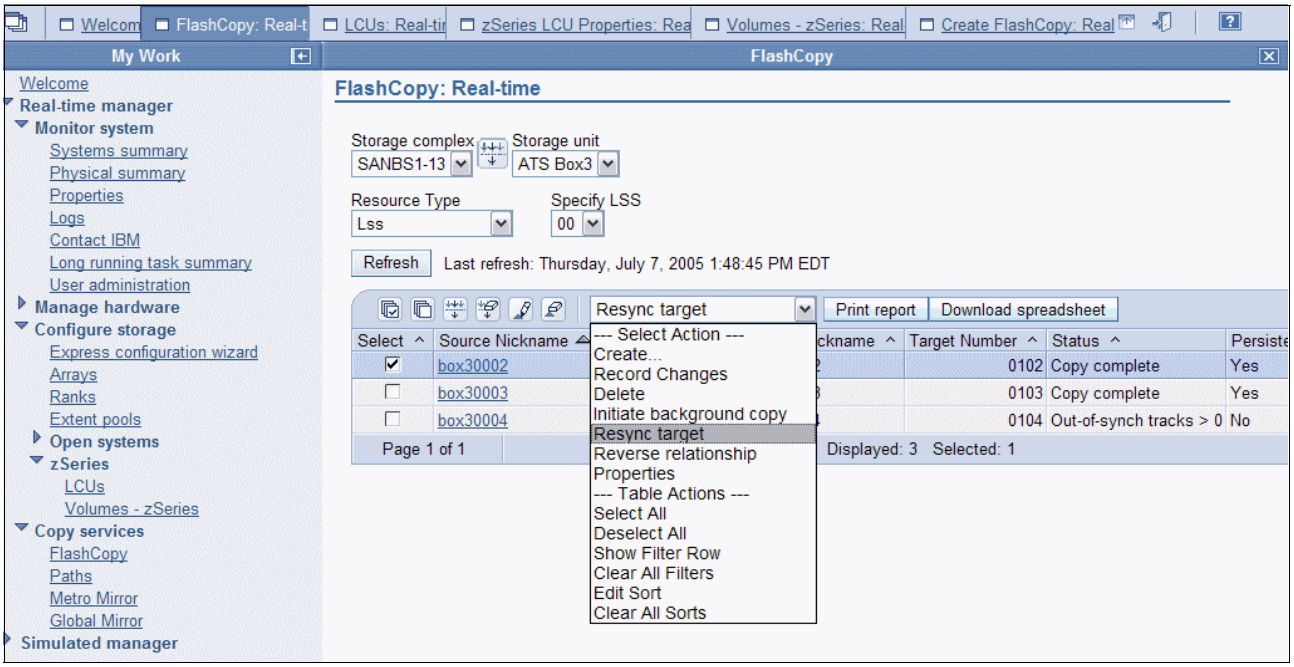

Figure 9-11 Resynchronize the FlashCopy relationship

The following prompt window asks for more details for the resync request; see Figure 9-12.

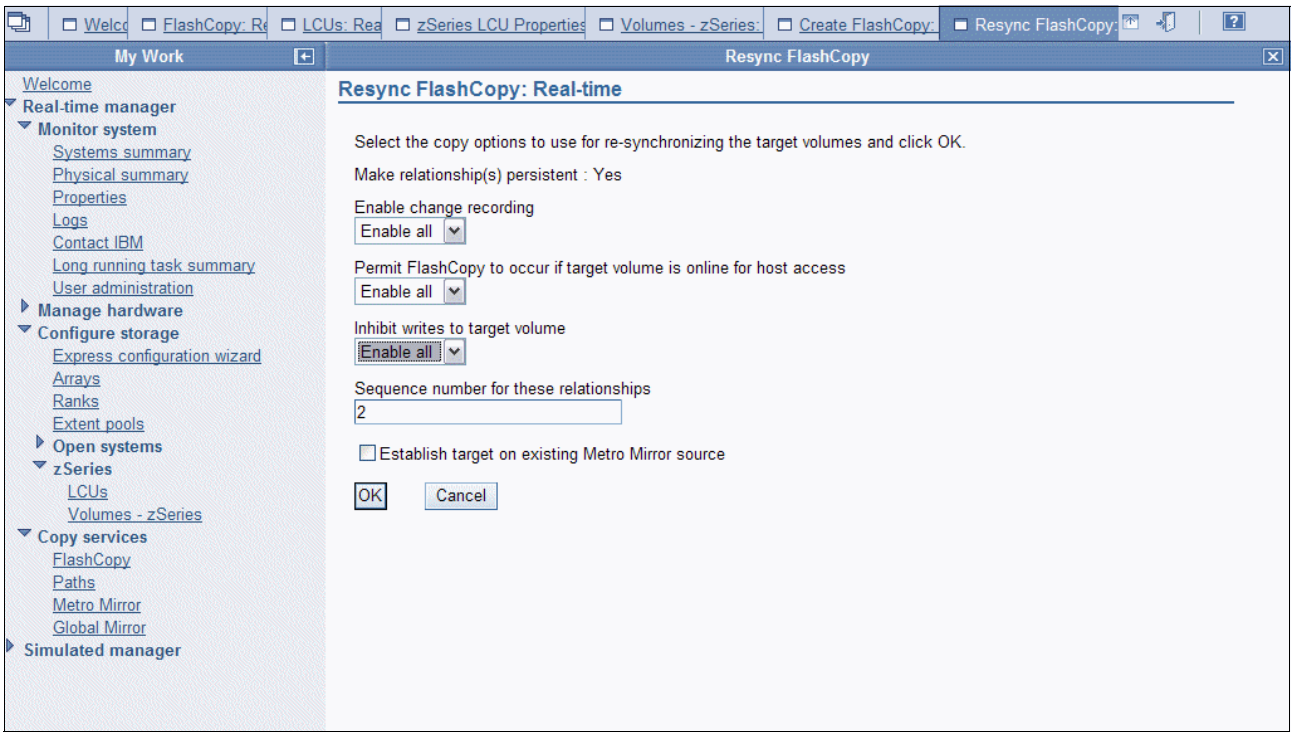

Figure 9-12 Prompt window to detail resync request for FlashCopy relationship

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9.6.6 Delete existing FlashCopy relationship

To delete an existing FlashCopy relationship, start by displaying the list of active FlashCopy relationships, as shown in Figure 9-13. Then check the box at the left of the FlashCopy relationship you want to terminate. Doing so, the available **Select Actions** for this FlashCopy relationship will be shown. Then select **Delete**.

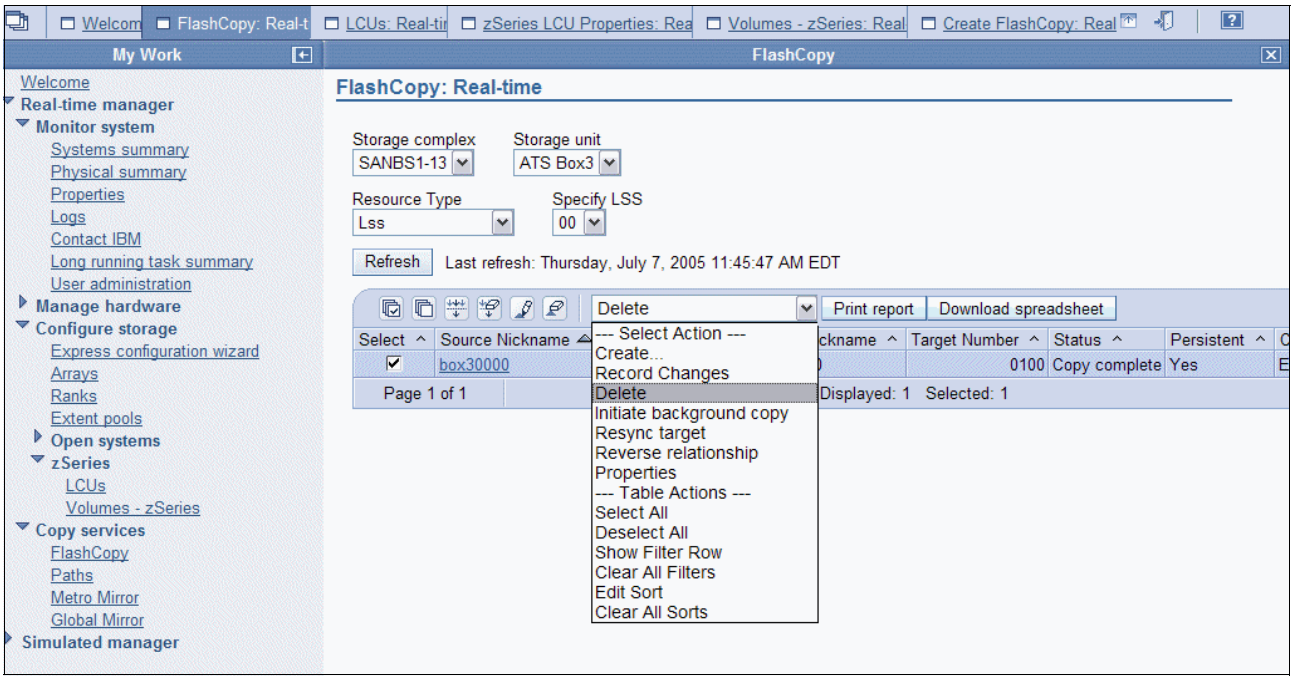

Figure 9-13 Select Action - Delete, to delete an existing FlashCopy relationship

The next window is a prompt asking you to confirm the delete request; see Figure 9-14.

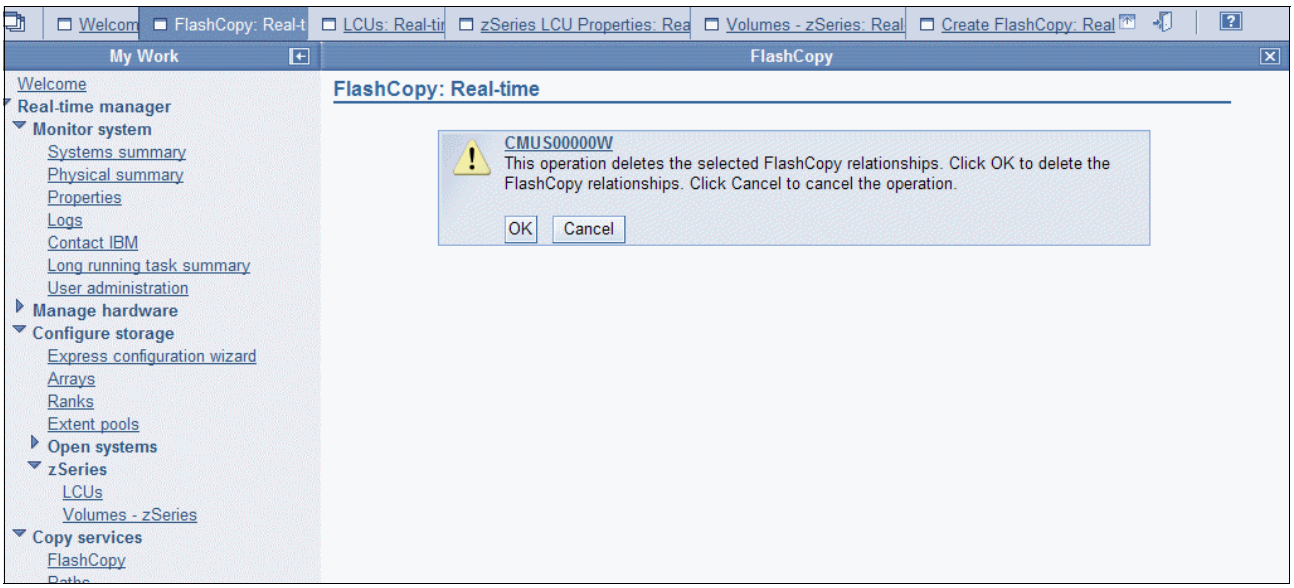

Figure 9-14 Prompt window to confirm delete request for FlashCopy relationship

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9.7 z/OS interfaces for local FlashCopy

The following z/OS-provided interfaces can be used for FlashCopy management:

- DFSMSdss utility
- TSO commands
- ANTRQST macro
- ICKDSF utility

9.7.1 Initiating FlashCopy using DFSMSdss

DFSMSdss has the COPY command that uses FlashCopy for volume copies and data set copies. Detailed information can be found in *z/OS DFSMSdss Storage Administration Reference*, SC35-0424.

For the best performance during COPY operations with DFSMSdss, it is recommended that you specify any of the parameters in Table 9-8, as applicable for the task to be done.

Table 9-8 Parameters that may improve the performance

DFSMSdss COPY command parameters	Performance improvements
ADMINISTRATOR	Allow a DFSMSdss-authorized administrator to bypass access checking to data sets and catalogs
ALLDATA(*)	Copy all allocated space (for organization type PS, PSU, PO, POU or null.
ALLEXCP	Copy all allocated space (for organization type PS, PSU, PO, POU or null), even if data sets are empty.
PURGE	Unexpired data sets on the target volume can be overlaid for a full or track copy operation

Full volume FlashCopy

DFSMSdss can implicitly use the hardware function of the DS6000 to perform a FlashCopy if the following conditions are met in conjunction with the COPY FULL command:

- The source and target volumes must have the same track format.
- The source volumes and target volumes are in the same DS6000.
- The source and target volumes must be online.
- No other FlashCopy is active for the same source volume.
- The FASTREPLICATION(NONE) keyword must *not* be specified.

Not all tracks on the volume are copied when DFSMSdss invokes FlashCopy for a full volume copy; DFSMSdss requests FlashCopy for allocated extents only.

In order to achieve balance between excluding free space and saving the number of FlashCopy relationships, up to 255 relations will be created for each full volume copy. If there are more than 255 extents on the volume, extents will be merged (to reduce the number of extents) resulting in some free space being copied.

Table 9-6 on page 88 shows the parameters used with the DS CLI command **`mkflash`** and the corresponding selections you can make when using the DS SM **Select Action → Create**. Table 9-9 on page 98 shows the options and parameters for DFSMSdss COPY FULL.

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Table 9-9 Options and parameters used for FlashCopy with DFSMSdss COPY FULL

Options	Parameter with DFSMSdss COPY FULL	Remark
Options for the source volume		
Multiple relationship FlashCopy	selected pairs	
Consistency Groups for FlashCopy	FCCGFREEZE CGCREATE FCCGVERIFY	see note (1)
Options for the target volume		
FlashCopy target can be Metro Mirror or Global Copy primary	FCTOPPRCPrimary	
Permit target volume to be online —z/OS environment	no specific parameter required	volume online / offline will be handled by DFSMSdss as required
Inhibit writes to target volume		not supported
Options for FlashCopy pair		
Identification of FlashCopy pair		in the commands
Incremental FlashCopy Persistent FlashCopy Change Recording	FCINCREMENTAL FCINCREMENTALLAST FCINCRVERIFY FCWAIT	Persistent and change recording available via Incremental relationships. Also, see note (1)
Do not perform full volume background FlashCopy	FCNOCOPY	also used: FCNC
Change copy mode (no copy to full background copy)	FCNOCOPYTOCOPY	see note (1)
Sequence number		not supported
Options for DFSMSdss to force selection of FlashCopy		
FlashCopy as preferred copy method for DFSMSdss	FASTREPLICATION	
Note: With z/OS V1R6 or later, and APARs OA11002, OA12707, OA12748, and OA14105		

The following considerations apply to the supported options:

- Multiple relationship FlashCopy

  It is possible to establish up to 12 FlashCopy relationships using the same source. When setting up a FlashCopy, it is necessary to determine whether the source volume might be used in other FlashCopy relationships as well. Once a source volume is used in a FlashCopy without identifying it as a multiple relationship source volume, it is not possible to define other FlashCopies using this volume as source volume. Once established using the DS SM, this attribute cannot be changed for an existing FlashCopy relationship.

- Consistency Groups for FlashCopy

  You can use the FlashCopy Consistency Group function to minimize application impact when making consistent copies of data spanning multiple volumes. The procedure consists of freezing the source volume during each volume copy operation, and thawing all the frozen volumes using the CGCREATE command after a FlashCopy Consistency

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Group has been formed. During the time period between the first and last volumes being frozen, no dependent write updates will occur, which allows a consistent copy of logically related data that spans multiple volumes.

Freezing the source volumes: You can use the FCCGFREEZE keyword on the COPY FULL or COPY TRACKS CPVOLUME command to specify that the FlashCopy source volume is to be part of a FlashCopy Consistency Group. Subsequent I/O activity to the source volumes will be held (frozen) as each volume is copied. A frozen volume remains in long busy state until the Consistency Group Created (*thaw*) command is processed on the logical subsystem (LSS) where the volume resides, or when the FlashCopy Consistency Group timer expires.

Thawing the frozen volumes: When all volume copy operations have completed, you can use the DFSMSdss CGCREATE command to allow I/O activity to resume on the frozen volumes (thaw the volumes) residing in the logical subsystems. The required ACCESSVOL keyword specifies one or more volumes residing in the LSS to which the *thaw* command will be directed. Only one volume needs to be specified for each LSS containing frozen volumes in the FlashCopy Consistency Group.

Verifying the Consistency Group: You can use the FCCGVERIFY keyword on the CGCREATE command to validate the state of the FlashCopy Consistency Group before thawing all the volumes. This will help you determine whether the copies of the group of volumes are consistent. An error message is issued if the frozen state cannot be verified. Regardless of the verification result, DFSMSdss will proceed to thaw all the volumes in the designated logical subsystems.

- Establish a target on existing Metro Mirror primary

  When this option is selected, the FlashCopy target volume can be, or can become, a primary volume for a Metro Mirror or Global Copy relationship. When FlashCopy is not invoked by the DFSMSdss utility, then FCTOPPRCPrimary is ignored.

  When FCTOPPRCPrimary is not specified, or if the capability is not supported by the DS6000, a Metro Mirror or Global Copy primary volume is not eligible to become a FlashCopy target volume.

  Note: A Metro Mirror volume pair in full duplex state will go to a duplex pending state when the FlashCopy relationship is established. When Metro Mirror completes the copy operation, the volume pair returns to the full duplex state.

- Permit FlashCopy to occur if target volume is online for host access

  When setting up the relationship, it is checked whether the target volume is online or not. See Table 9-10 for valid combinations of *offline* and *online* for volumes.

Table 9-10 Resulting actions from target being online or offline

Status of target volume in z/OS	Permit FlashCopy to occur if target volume is online	Resulting action
volume is online	not selected	FlashCopy definition is not possible.
volume is online	selected	FlashCopy definition is queued until target volume goes offline
volume is offline	selected or not selected	FlashCopy will be started immediately

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- Incremental FlashCopy, Persistent FlashCopy, Change Recording option

  Incremental FlashCopy operates at the full volume level. You can use Incremental FlashCopy to create an initial point-in-time copy of a source volume and refresh the target volume by copying only the changed data. After the initial full volume copy of the source volume to the target volume, the FlashCopy relationship remains (persists) between the source and target volume pair and the changes on the source and target volumes since the last point-in-time copy are tracked. When you refresh the target volume at a new point-in-time, only the changed tracks are copied.

  The direction of the refresh can be reversed when you indicate that the original target now becomes the source and the original source becomes the target.

  You can use the FCINCREMENTAL keyword for a COPY FULL or COPY TRACKS CPVOLUME operation to perform an initial full volume copy if no Incremental FlashCopy relationship exists between the volume pair. If there is an existing Incremental FlashCopy relationship between the volume pair, DFSMSdss will copy the changed tracks in the (new) direction designated by the INDDNAME/INDYNAM and OUTDDNAME/OUTDYNAM keywords. The new direction can be the same or the reverse of the original (existing) direction.

  You can use the FCINCREMENTALLAST keyword on the COPY FULL or COPY TRACKS CPVOLUME commands to copy the changed tracks when there is an Incremental FlashCopy relationship between the volume pair. FCINCREMENTALLAST specifies that the new FlashCopy relationship will be nonpersistent and Change Recording will be stopped after the final increment has been established. The FlashCopy relationship will end when background copy for the final increment has completed.

  You can use the FCINCRVERIFY(NOREVERSE | REVERSE) keyword to verify that the existing Incremental FlashCopy direction is what you expected. DFSMSdss will fail the copy attempt if the existing direction is not as expected.

  When you reverse the direction of an Incremental FlashCopy, the storage facility requires that the previous background copy has completed. You can specify the FCWAIT keyword with a query interval value in seconds and a number of retries value to direct DFSMSdss to wait for background copy completion before initiating the new Incremental FlashCopy.

- No full volume background copy

  It is possible to determine whether the data of the source volume should be copied to the target volume in the background or not. If DFSMSdss uses the DS6000 FlashCopy, the parameter FCNOCOPY is analyzed to determine whether a copy should take place or not. If FCNOCOPY is specified, the FlashCopy relationship stays persistent and only updates to the source are reflected in the target. If this parameter is omitted, then a physical copy of the data is done in the background and the FlashCopy relationship is ended after all data has been copied.

- Change copy mode, no copy to full background copy

  When an existing FlashCopy relationship is converted from no-background copy (FCNOCOPY) to background copy mode, the relationship ends (unless the relationship is persistent) when the background copy has completed.

  You can change the existing FlashCopy copy mode by performing a physical full volume or tracks copy specifying the FCNOCOPYTOCOPY keyword along with the source volume or extents for which you want background copy to be started. The FCNOCOPYTOCOPY function will initiate background copy of any NOCOPY FlashCopy relationships in which the specified source volume or extents are participating.

  In general, if you want a temporary copy of the data, specify FCNOCOPY and then withdraw the FlashCopy relationship when you no longer need the copy. If you want a permanent copy, but want to delay background copy until a convenient time, specify

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FCNOCOPY to get a point-in-time copy and then perform FCNOCOPYTOCOPY later to start background copy. If you want a permanent copy and do not want to delay background copy, do not specify FCNOCOPY.

- FlashCopy as preferred copy method for DFSMSdss

  The parameter FASTREPLICATION can be used to identify whether the DS6000 FlashCopy should be used or not. See Table 9-11 for the possible values and the corresponding actions.

Table 9-11 Combinations of volume offline or online and parameter permit target to be online

parameter	
FASTREPLICATION(PREFERRED)	This is the default. For DFSMSdss the DS6000 FlashCopy is the preferred method for data copy. If FlashCopy cannot be used, the parameter CONCURRENT is used to identify Concurrent Copy to be used. If CONCURRENT is not used or the Concurrent Copy fails, then traditional data copy methods will be used.
FASTREPLICATION(REQUIRED)	For DFSMSdss the DS6000 FlashCopy is the required method to copy the volume. If FlashCopy cannot be used, DFSMSdss fails the operation with error message ADR938E.
FASTREPLICATION(NONE)	DFSMSdss will not try to use the DS6000 FlashCopy.

Data set FlashCopy

DFSMSdss can implicitly use the hardware function of the DS6000 to perform a FlashCopy if the following conditions are met in conjunction with the COPY DATASET command:

- The source and target types are the same.
- The source devices and target devices are in the same DS6000.
- The source and target volumes must be online.

Note: Do not use FASTREPLICATION(NONE), because it prevents the use of FlashCopy.

The COPY DATASET command can be used with the parameters listed in Table 9-12.

Table 9-12 Parameters with COPY DATASET

Parameters with COPY DATASET	**Performance improvements**
NOPACKING	If COPY DATASET is used for a partitioned data set, the nopacking option specifies that the data set is not to be compressed during copy. This allows DFSMSdss to invoke FlashCopy for the copy operation.
FCNOCOPY	If FlashCopy is used to perform the copy operation, then do not perform a full background copy of the data.
ALLEXCP	Copy all allocated space (for organization type PS, PSU, PO, POU or null), even if data sets are empty.
PURGE	Unexpired data sets on the target volume can be overlaid for a full or track copy operation.

Depending on the type of data set, however, the DFSMSdss command COPY DATASET does not always invoke the FlashCopy hardware function to perform the copy. Table 9-13 on page 102 shows which functions are invoked by DFSMSdss, depending on the type of data set.

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Table 9-13 Data mover for data set copy (to device of same geometry)

Data set type	Data mover	Notes
Sequential	DFSMSdss	
Partitioned (not PDSE)	DFSMSdss / IEBCOPY	All partitioned data sets that are not load modules are compressed during a copy. Specify NOPACKING if FlashCopy is to be used.
Partitioned (not PDSE) load modules	DFSMSdss / IEBCOPY	If copying partitioned load modules with REBLOCK, DFSMSdss calls IEBCOPY to copy the data set to a like device.
Partitioned data set extended (PDSE)	DFSMSdss / IGWFAMS	DFSMSdss calls the IGWFAMS utility when you are converting a PDS to a PDSE.
Direct nonrelative block address mode	DFSMSdss	
Direct relative block address mode	DFSMSdss	Specify the DFSMSdss RELBLOCKADDRESS parameter.
Indexed sequential to same track. Target volume uses VTOC index. Target space available.	DFSMSdss	
Indexed sequential (all other cases)	IEBISAM	
ESDS	DFSMSdss / IDCAMS	DFSMSdss calls IDCAMS if the target CISIZE, CASIZE, physical record size, or physical block size of the target is different from that of the source.
RRDS	DFSMSdss / IDCAMS	DFSMSdss calls IDCAMS if the target CISIZE, CASIZE, physical record size, or physical block size of the target is different from that of the source.
LDS	DFSMSdss/IDCAMS	DFSMSdss calls IDCAMS if the target CISIZE, CASIZE, physical record size, or physical block size of the target is different from that of the source.
KSDS or VRRDS	DFSMSdss / IDCAMS	DFSMSdss calls IDCAMS if any of the following are true: ► The CISIZE, CASIZE, physical record size, physical block size, imbed, or span attributes of the target are different from that of the source. ► The target data set is SMS and has an imbedded index or has key ranges, and the target volume count is greater than one. ► The target data set is non-SMS, the source component or components span multiple volumes, and there is not enough space on one target volume to contain the entire data set.
Key range data set	DFSMSdss / IDCAMS	DFSMSdss calls IDCAMS if the source and target CASIZE, physical record size, or physical block size are different; if the components span multiple volumes; for a KSDS with IMBED and either the source HURBA=HARBA or it has extended indexes.
Extended-format VSAM	DFSMSdss / IDCAMS	DFSMSdss calls IDCAMS if the target CISIZE, CASIZE, physical record size, or physical block size of the target is different from that of the source.

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Data set type	Data mover	Notes
Integrated catalog facility user catalogs	IDCAMS (EXPORT/IMPORT)	
Undefined DSORG	DFSMSdss	

9.7.2 FlashCopy using TSO commands

In this section we describe the FlashCopy functions invoked via TSO commands and parameters. For more detailed information about the TSO FlashCopy commands, refer to *DFSMS Advanced Copy Services,* SC35-0428.

Consistency Group FlashCopy

In order to create a Consistency Group with a set of FlashCopy volumes, use the TSO FCESTABL command with the ACTION(FREEZE) parameter as shown in Example 9-13.

The FlashCopy relationship is established between the source and target volumes, or extents, and all I/O to the source volumes is put on hold (extended long busy) until one of the following conditions is met:

- A FlashCopy withdraw - FCWITHDR with ACTION(THAW) is processed by the LSS where the volumes reside.
- A two-minute timer expires.

Example 9-13 Create a FlashCopy consistency group with FCESTABL and ACTION(FREEZE)

```
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                               *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3500') TDEVN(X'4500') ACTION(FREEZE)
  FCESTABL SDEVN(X'3501') TDEVN(X'4501') ACTION(FREEZE)
  FCESTABL SDEVN(X'3502') TDEVN(X'4502') ACTION(FREEZE)
  FCESTABL SDEVN(X'3503') TDEVN(X'4503') ACTION(FREEZE)
  FCESTABL SDEVN(X'3504') TDEVN(X'4504') ACTION(FREEZE)
/*
```

Incremental FlashCopy

With incremental FlashCopy, the relationship remains active after initial copy is complete. This allows subsequent changes to be tracked so that future FlashCopy operations require only a subset of the volume to be copied—only the data that has changed.

As shown in Example 9-14 on page 104, the TSO FCESTABL command with INCREMENTAL(YES) is used to establish a FlashCopy relationship which will remain until explicitly terminated with a FlashCopy withdraw request (the TSO FCWITHDR command).

The FlashCopy target is write-inhibited while the incremental relationship is active. Any attempt to write to the device during this period will be failed by the hardware and reported as an I/O error, an error from the access method, or both.

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Example 9-14 Incremental FlashCopy invoked with FCESTABL and INCREMENTAL(YES)

```
//*******************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                             *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                              *
//*    TDEVN - TARGET FLASHCOPY VOLUME                              *
//*******************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3500') TDEVN(X'4500') INCREMENTAL(YES)
  FCESTABL SDEVN(X'3501') TDEVN(X'4501') INCREMENTAL(YES)
/*
```

Note: Incremental FlashCopy is only supported for full volumes, with a limit of one full volume incremental relationship per volume. A single Incremental relationship can coexist with as many as eleven nonincremental relationships per track, up to the maximum number of FlashCopy relationships allowed on the volume. The normal FlashCopy restrictions apply to the target tracks of an incremental relationship.

Full volume background copy

The type of the FlashCopy operation is specified with the TSO FCESTABL command and MODE parameter. If a MODE(COPY) option is specified (see Example 9-15) then a full volume copy is performed in the background. The FlashCopy relationship ends when the background copy is completed or the FCWITHDR command is issued. If you specify MODE(COPY), data on the target device is overlaid within the track extents specified. In case the MODE parameter is omitted on the FCESTABL command, then a full volume copy will take place.

Example 9-15 Full volume background copy - FCESTABL with MODE(COPY)

```
//*******************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                             *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                              *
//*    TDEVN - TARGET FLASHCOPY VOLUME                              *
//*******************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3500') TDEVN(X'4500') MODE(COPY)
  FCESTABL SDEVN(X'3501') TDEVN(X'4501')
/*
```

FlashCopy NOCOPY option

In case that MODE(NOCOPY) is used in a FlashCopy relationship between the source and target devices for the specified volume or extent ranges, the background copy operation is not initiated (see Example 9-16 on page 105).

When the DS6000 receives an update to a source track in a FlashCopy NOCOPY relationship, a copy of the point-in-time (pre-update) data is preserved on the target volume. A FlashCopy relationship established in NOCOPY mode remains active until one of the following occurs:

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- All specified source device tracks are updated.
- The DS6000 copies all tracks from source to target when a threshold number of source tracks are updated.
- A FlashCopy withdraw (using the FCWITHDR command) is issued to remove the FlashCopy relationship.
- A NOCOPY relationship is converted to a COPY relationship through the NOCOPY2COPY mode option.

Example 9-16 FlashCopy NOCOPY option

```
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                               *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3500') TDEVN(X'4500') MODE(NOCOPY)
  FCESTABL SDEVN(X'3501') TDEVN(X'4501') MODE(NOCOPY)
/*
```

Note: When a FlashCopy NOCOPY relationship is ended, the data remaining on the target device is unpredictable and should not be used. Also consider that tracks may be copied from the source to the target volume even if the source track is not changed. This includes the track that contains the volume label. Therefore, to avoid duplicate volume serial problems when the target device is later varied online, we recommend that you relabel the target volume after withdrawing a volume-level FlashCopy NOCOPY relationship.

One of the reasons for the NOCOPY option is for backing up to tape. The FlashCopy NOCOPY parameter generates a logical copy of source data that can be read from another device (target). This allows read activity (from the target device) to be separate from application read/write activity on the source device. A backup program such as DFSMSdss can use the target device as input for backing up data to tape.

Change the NOCOPY to full volume copy relationship

In order to change the NOCOPY relationship to a full volume copy, use the TSO FCESTABL command with the MODE(NOCOPY2COPY) option (shown in Example 9-17). This starts a background copy for source NOCOPY relationships intersecting with the extents specified. The relationships end when the background copy is completed.

Example 9-17 TSO FCESTABL and MODE(NOCOPY2COPY)

```
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                               *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3500') TDEVN(X'4500') MODE(NOCOPY2COPY)
```


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FlashCopy to Metro Mirror or Global Copy primary volume

This FlashCopy option allows you to establish a FlashCopy pair where the FlashCopy target is the primary device in a Metro Mirror (or Global Copy) pair. In this way you can create a point-in-time copy and then make a copy of that point-in-time copy at a remote site.

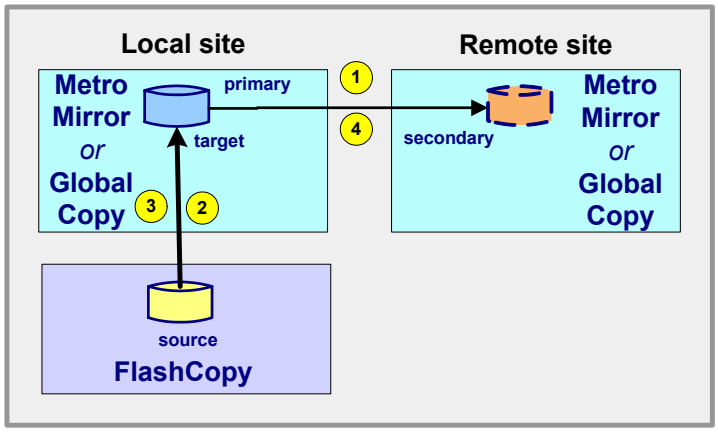

Figure 9-15 FlashCopy to Metro Mirror or Global Copy primary

A FlashCopy to a Metro Mirror (or Global Copy) primary configuration is set up as follows (refer to Figure 9-15):

1. Establish the Metro Mirror pair from the local to the remote site and allow the pair to reach full duplex state.
2. When you want to make a point-in-time copy of a volume at the local site, establish a FlashCopy relationship with the primary Metro Mirror volume as the target, specifying MODE(COPY) and TGTPPRIM(YES) with the FCESTABL command. When the FlashCopy is requested, the state of the Metro Mirror pair is changed from *duplex* to *pending*.
3. When the background copy on the target FlashCopy volume (which is at the same time the primary Metro Mirror volume) is complete, the FlashCopy relationship is ended—unless INCREMENTAL(YES) was specified. Resynchronization of the Metro Mirror pair begins.
4. When the Metro Mirror pair is resynchronized, the state returns to duplex and the point-in-time copy is available at the secondary volume at the remote site.

A FlashCopy to a Metro Mirror primary volume can be used with the INCREMENTAL(YES) option. This results in the Metro Mirror primary using incremental updates to resynchronize with the Metro Mirror secondary volume.

Inband FlashCopy

The Inband FlashCopy option allows FlashCopy requests to be issued remotely through an existing remote mirror and copy link—Metro Mirror or Global Copy link.

As shown in Example 9-18 on page 107, the FCESTABL command is issued with the REMOTE(YES) parameter. Once the FlashCopy is established, the direct host connection from local to remote DS6000 is not required for a background copy to complete. The host connection would be needed, however, before any new FlashCopy tasks could be initiated.

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Inband FlashCopy can be useful if the host at the recovery site is not online. The Inband option eliminates the need for a host connection from local to remote exclusively for FlashCopy backup. The FlashCopy request must be issued at a host processor connected to the remote mirror or copy primary volume, with the remote mirror or copy secondary volume specified as the FlashCopy source.

Example 9-18 Inband FlashCopy

```
//*********************************************************************
//*    ESTABLISH INBAND FLASHCOPY RELATIONSHIP                        *
//*    DEVN - METRO MIRROR PRIMARY VOLUME AT LOCAL SITE               *
//*    SOURCE - DS6000 SERIAL NO, LSS, CCA AT REMOTE SITE             *
//*    TARGET - DS6000 SERIAL NO, LSS, CCA AT REMOTE SITE             *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL DEVN(X'3500') SOURCE(ABTV1 05 0A) -
                         TARGET(ABTV1 05 0B) -
                         MODE(COPY) SSID(4500) REMOTE(YES)
/*
```

In the Example 9-18, the REMOTE(YES) parameter specifies that this relationship is to be located on the remote DS6000 storage subsystem identified by SSID 4500. This must be the same as the SSID value specified for the Metro Mirror secondary on the TSO CESTPAIR command. DEVN 3500 is the Metro Mirror primary through which the FCESTABL command will be passed.

FlashCopy in a Global Mirror session

Example 9-19 shows the TSO FCESTABL command with MODE(ASYNC), which is used when FlashCopy is part of a Global Mirror configuration. Since the ASYNC mode establishes an incremental relationship, the INCREMENTAL(YES) parameter is not needed. In addition, the FlashCopy target is write-inhibited.

Example 9-19 TSO FCESTABL and MODE(ASYNC)

```
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP FOR GLOBAL MIRROR SESSION     *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3500') TDEVN(X'4500') MODE(ASYNC)
  FCESTABL SDEVN(X'3501') TDEVN(X'4501') MODE(ASYNC)
/*
```

Fast Reverse Restore is another function to be used with a Global Mirror configuration. It is used when recovering from an outage. This function reverses the direction of the FlashCopy relationship when change recording is active (incremental FlashCopy), restoring the source volume to the state it was in when it last flashed to the target. Changed tracks are copied back from the target to the source.

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As shown in Example 9-20, Fast Reverse Restore is invoked with the FCESTABL command and the ACTION(FRR) parameter.

Example 9-20 FlashCopy Fast Reverse Restore function

```
//*******************************************************
//*   THIS JOB WILL REVERSE THE DIRECTION OF FLASHCOPY
//*     ORIGINAL SOURCE = 3500, FRR SOURCE = 4500
//*     ORIGINAL TARGET = 4500, FRR TARGET = 3500
//*******************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'4500') TDEVN(X'3500') ACTION(FRR)
/*
```

In Example 9-20, we reversed the FlashCopy direction for the previously established FlashCopy relationship between volume 3500 (source) and 4500 (target), by specifying 4500 as a source volume and 3500 as a target volume.

Revert is a function to be used with Global Mirror for DS6000 when recovering from an outage. It specifies a rollback to the state saved by a previous automatic FlashCopy establish command. Revert is a function that is invoked with the FCWITHDR command and the ACTION(REVERT) parameter. The FlashCopy relationship is not removed (withdrawn) but the FlashCopy target is rolled back to the previous consistency group created by the Global Mirror session. For more information, refer to 23.7.4, “Check for valid Consistency Group state” on page 285.

Withdraw FlashCopy relationships

TSO FCWITHDR is used to remove existing FlashCopy relationships. The FlashCopy withdraw process locates source tracks on the source device and target tracks on the target device, and ends the FlashCopy relationship between them.

This command can be used on FlashCopy relationships whether or not a background copy is in progress. The FCWITHDR command provides a method of manually withdrawing the relationship.

Note: When a FlashCopy NOCOPY relationship is ended, the track data on the target device is unpredictable and should not be used. Also consider that tracks may be copied from the source to the target volume even if the source track is not changed. This includes the track that contains the volume label. Therefore, to avoid duplicate volume serial problems when the target device is later varied online, we recommend that you relabel the target volume after withdrawing a volume-level FlashCopy NOCOPY relationship.

The following examples show different options used to terminate FlashCopy relationships.

In Example 9-21 on page 109, specification of the TDEVN parameter without the SDEVN parameter allows you to withdraw all FlashCopy relationships that have target extents on the specified TDEVN, regardless of what source volumes are involved in those FlashCopy relationships. In this case, the withdraw processing identifies where the source tracks are (volume and track location) and removes all information about the relationships from all devices involved.

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Example 9-21 FlashCopy withdraw target only

```
//*********************************************************************
//*    WITHDRAW FLASHCOPY RELATIONSHIP                                *
//*    TARGET ONLY                                                    *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCWITHDR TDEVN(X'320B')
/*
```

In Example 9-22, both the SDEVN parameter and the TDEVN parameter allow you to limit the scope of the withdraw to those FlashCopy relationships that have source extents on the specified SDEVN and corresponding target extents on the TDEVN, regardless of whatever source and target relationships with other devices may exist.

Example 9-22 FlashCopy withdraw source and target

```
//*********************************************************************
//*    WITHDRAW FLASHCOPY RELATIONSHIP                                *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCWITHDR SDEVN(X'320A') TDEVN(X'320B')
/*
```

The FCWITHDR command with the DDSW(YES) (*deleted data space withdraw)* parameter, when issued against an entire source volume, removes all target extents on the specified source device from their associated FlashCopy relationships. In addition, any FlashCopy NOCOPY source tracks on the specified source device are changed to COPY (background copy) source tracks. This process causes all source tracks to be copied to their respective target tracks and all FlashCopy relationships to be removed from the specified source device.

The FCWITHDR command in Example 9-23 withdraws all source extents on the source device 320A from their associated FlashCopy relationships regardless of the location of their corresponding target extents, and all target extents on the source device regardless of the location of the corresponding source extents.

Example 9-23 FCWITHDR and DDSW parameter

```
//*********************************************************************
//*    WITHDRAW FLASHCOPY RELATIONSHIP                                *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    DDSW(YES)                                                      *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCWITHDR SDEVN(X'320A') DDSW(YES)
```


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```
/*
```

The main benefit of the DDSW(YES) parameter is that it can be used to easily free up tracks on both the source and the corresponding target volumes that are in FlashCopy relationships that are no longer needed because the original source data—that justified the relationship—has been deleted. Another example might be that prior to starting a backup cycle using DFSMSdss, you might want to make sure that all relationships have been cleaned up on the subject source volume. More details on this subject can be found in *DFSMS Advanced Copy Services,* SC35-0428.

Displaying information for volumes in a FlashCopy relationship

The TSO FCQUERY command is used to display available information about FlashCopy and other copy services relationships active on the device. If the device is not in a source or target FlashCopy relationship, the FCQUERY report shows the number of active FlashCopy relationships as 0.

As shown in Example 9-24, the FCQUERY output report indicates that device 350A has one active FlashCopy relationship (ACT=1) and is in a remote mirror session as a secondary device (PC=S). The very same device is not in a z/OS Global Mirror session (XC=N), nor in a Concurrent Copy (CC=N), and it has a nonrevertible status (RV=N).

Example 9-24 FlashCopy report - FCQUERY

```
FCQUERY DEVN(350A)
*******************************************************************************************
ANTF0420I FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
420A 4200  02  0A 1750 0000000ABTV1      1  50099  N  S  N  N 00000000
```


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10

FlashCopy performance

This chapter discusses best practices when configuring FlashCopy for specific environments or scenarios. The following topics are covered:

- FlashCopy performance overview
- FlashCopy establish performance
- Background copy performance
- FlashCopy impact to applications
- FlashCopy options
- FlashCopy scenarios

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10.1 FlashCopy performance overview

Many parameters can affect the performance of FlashCopy operations. It is important to review the data processing requirements and hence select the proper FlashCopy options.

This chapter examines when to use the COPY versus the NOCOPY mode and where to place the FlashCopy source and target volumes/LUNs. We also discuss when and how to use *incremental* FlashCopy—which should definitely be evaluated for use in most applications.

Note: This chapter is equally valid for System z volumes and open systems LUNs. In the following sections only the term *volume* or *volumes* will be used, but the text is equally valid if the terms LUN and LUNs were used, *unless otherwise noted*.

Terminology

Before proceeding with the discussion of FlashCopy best practices, lets review some of the basic terminology we will be using in this chapter.

Server - A DS6000 has two servers—Server 0 and Server 1, one on each controller card—and each server independently provides major functions for the disk subsystem: Directing *host adapters* for data transferring to and from host processors, managing *cache* resources, and directing lower *device adapters* for transferring data to and from physical disks. You can issue the **`lsserver`** command to see the available servers.

Device Adapter (DA) - A physical component of the DS6000 that provides communications between the servers and the storage devices. The **`lsda`** command lists the available device adapters.

Rank - An array site made into an array which is then made into a rank. For the DS6000 a rank is a collection of 8 disk drive modules (DDMs). The **`lsrank`** command displays detailed information about the ranks.

10.1.1 Distribution of the workload - Source and target volumes location

In general, you can achieve the best performance by distributing the load across all of the resources of the DS6000. In other words, you should carefully plan your usage so that the load is:

- Spread evenly across disk subsystems
- Within each disk subsystem, spread evenly across servers
- Within each server, spread evenly across device adapters
- Within each device adapter, spread evenly across ranks

Additionally, it is always best to locate the FlashCopy target volume on the same DS6000 server as the FlashCopy source volume. It is also good practice to locate the FlashCopy target volume on a different device adapter (DA) than the source volume, but there are some cases where this is really a *don't care* decision.

Another choice available is whether to place the FlashCopy target volumes on the same ranks as the FlashCopy source volumes. In general it is best not to place these two volumes in the same rank. Refer to Table 10-1 on page 113 for a summary of the volume placement considerations.

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Tip: If the FlashCopy target volume is on the same rank as the FlashCopy source volume, you run the risk of a rank failure causing the loss of both the source and the target volume.

Table 10-1 FlashCopy source and target volume location

	Server	Device Adapter	Rank
FlashCopy establish performance	Same server	Don't care	Different ranks
Background copy performance	Same server	Different device adapter	Different ranks
FlashCopy impact to applications	Same server	Don't care	Different ranks

Tip: To find the relative location of your volumes, you can use the following procedure:

1. Use the **`lsfbvol`** command to find out which Extent Pool contains the relevant volumes.
2. Use the **`lsrank`** command to display both the device adapter and the rank for each Extent Pool.
3. To determine which server contains your volumes, look at the Extent Pool name. Even numbered Extent Pools are always from Server 0, while odd numbered Extent Pools are always from Server1.

10.1.2 LSS/LCU versus rank considerations

In the DS6000 it is much more meaningful to discuss volume location in terms of ranks and not in terms of logical subsystem (LSS) or logical control unit (LCU). On the ESS 800 and earlier IBM disk subsystems, the physical locations of the volumes were described in terms of the logical subsystem LSS/LCU. If there existed more than a single rank in the LSS/LCU, then each of the ranks would have a range of volumes from that specific LSS/LCU.

The LSSs/LCUs in a DS6000 disk subsystem are logical constructs that are no longer tied to predetermined ranks. Within the DS6000 the LSS/LCU can be configured to span one or more ranks but is not limited to specific ranks. There can be individual ranks that contain volumes from more than a single LSS/LCU, which was not possible before the introduction of the DS6000.

10.1.3 Rank geometry

Finally, you can achieve a small performance improvement by using identical rank geometries for both the source and target volumes. In other words, if the source volumes are located on a rank with a 7+p/RAID-5 configuration, then the target volumes should also be located on a rank configured as 7+p/RAID-5.

10.1.4 Incremental FlashCopy

This chapter focuses on FlashCopy performance best practices, but there are many other business requirements that must be weighed when using FlashCopy. The designer should carefully consider all aspects for the implementation of each specific solution and should definitely evaluate the use of *incremental* FlashCopy for all FlashCopy applications.

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10.2 FlashCopy establish phase performance

The FlashCopy of a volume has two distinct periods:

- The *initial* logical FlashCopy (also called *establish*)
- The *physical* FlashCopy (also called *background* copy)

The FlashCopy establish phase, or *logical* FlashCopy, is the period of time when the microcode is preparing things, such as the bitmaps, necessary to create the FlashCopy relationship so the microcode can properly process subsequent reads and writes to the related volumes. During this logical FlashCopy period, no writes are allowed to the volumes. After the logical relationship has been established, normal I/O activity is allowed to both source and target volumes according to the options selected.

When there are a large number of volumes, the method used to invoke the FlashCopy commands can influence the time it takes to complete the logical FlashCopy for all FlashCopy pairs. An in-band invocation will source the commands to the microcode faster than an out-of-band method in most cases. An in-band establish is one that uses the CCW commands directly, like in z/OS.

The fastest out-of-band method is the DS CLI. The method to control or invoke FlashCopy should be selected based upon the total solution requirements and not strictly on *logical* FlashCopy performance considerations, unless this is a critical performance issue.

Additionally, there is a modest performance impact to logical FlashCopy performance when using incremental FlashCopy. In the case of incremental FlashCopy, the DS6000 must create additional metadata (bitmaps). However, the impact is negligible in most cases.

Finally, the placement of the FlashCopy source and target volumes has an effect on the establish performance. You can refer to the previous section for a discussion of this topic as well as to Table 10-1 on page 113 for a summary of the recommendations.

10.3 Background copy performance

The *background copy* phase, or *physical* FlashCopy, is the actual movement of data from the source volume to the target volume. If the FlashCopy relationship was established requesting the NOCOPY option, then only write updates to the source volume will force a copy from the source to the target. This forced copy is also called a *collision*.

Note: The term *collision* describes a forced copy from the source to the target because a write to the source has occurred. This occurs on the *first* write to a track. Note that since the DS6000 writes to non-volatile cache, there is typically no direct response time delay on host writes. The forced copy only occurs when the write is destaged onto disk.

If the COPY option was selected, then upon completion of the logical FlashCopy establish phase, the source will be copied to the target in an expedient manner.

If a large number of volumes have been established, then do not expect to see all pairs actively copying data as soon as their logical FlashCopy relationship is completed. The DS6000 microcode has algorithms that limit the number of active pairs copying data. These algorithms will try to balance active copy pairs across the DS6000 device adapter resources. Additionally, they will limit the number of active pairs such that there remains bandwidth for host or server I/Os.

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Tip: The DS6000 gives higher priority to application performance than background copy performance. This means that the DS6000 will throttle the background copy if necessary, so that applications are not unduly impacted.

The recommended placement of the FlashCopy source and target volumes, regarding the *physical* FlashCopy phase, was already discussed in the previous section. Refer to Table 10-1 on page 113 for a summary of the conclusions. For the best background copy performance, the implementation should always place the source and target volumes in different ranks. There are additional criteria to consider if the FlashCopy is a *full box copy* that involves all ranks.

Note: The term *full box copy* has the implication that all rank resources are involved in the copy process. Either all or nearly all ranks have both source and target volumes, or half the ranks have source volumes and half the ranks have target volumes.

For full box copies, you should still place the source and target volumes in different ranks. When all ranks are participating in the FlashCopy, it is still possible to accomplish this by doing a FlashCopy of volumes on rank R0 onto rank R1, and volumes on rank R1 onto rank R0 (for example). Additionally, if there is heavy *application* activity in the source rank, performance would be less affected if the background copy target was in some other rank that could be expected to have lighter *application* activity.

If background copy performance is of high importance in your environment, you should use incremental FlashCopy as much as possible. *Incremental* FlashCopy will greatly reduce the amount of data that needs to be copied, and therefore greatly reduce the background copy time.

10.4 FlashCopy impact on applications

One of the most important considerations when implementing FlashCopy is to achieve an implementation that has minimal impact to the users' application performance.

Note: As already mentioned, the recommendations discussed in this chapter only consider the performance aspects of a FlashCopy implementation. But FlashCopy performance is only one aspect of an intelligent system design. You must consider all business requirements when designing a total solution. These additional requirements—together with the performance considerations—will guide you when choosing FlashCopy options like COPY or NOCOPY and *incremental*, as well as when making choices on source and target volume locations.

The relative placement of the source and target volumes has a significant impact on application performance, and this has already been discussed in 10.1.1, "Distribution of the workload - Source and target volumes location" on page 112.

In addition to the relative placement of volumes, the selection of COPY or NOCOPY is also an important consideration in regard to the impact on application performance. Typically, the choice of COPY or NOCOPY depends primarily on how the FlashCopy will be used and for what interval of time the FlashCopy relationship exists. From a purely performance point of view, the choice of whether to use COPY or NOCOPY depends a great deal on the type of workload. The general answer is to use NOCOPY, but this is not always the best choice. For most workloads, including online transaction processing (OLTP) workloads, NOCOPY is

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typically the preferred option. However, some workloads that contain a large number of random writes and are not cache friendly might benefit from using the COPY option, which is typically the preferred option.

Another important performance consideration is whether or not to use *incremental* FlashCopy. Under the right circumstances, incremental FlashCopy should have no impact on the critical online write updates and should significantly shorten the period of time needed to complete the periodic background copy.

Note: The incremental FlashCopy **`resyncflash`** command does not have a NOCOPY option. Using **`resyncflash`** will automatically use the COPY option, regardless of whether the original FlashCopy was COPY or NOCOPY.

10.5 FlashCopy options - considerations

Incremental FlashCopy is only supported at the volume level. That is, *incremental* FlashCopy does not support z/OS data set level FlashCopy. Though incremental may be used with FlashCopy relationships established with either the COPY or the NOCOPY option, there are some differences in how the COPY and NOCOPY relationships affect the application write updates.

The COPY approach causes an initial copy of all source volumes, but then will only copy changed tracks when the incremental resync command is invoked. The NOCOPY approach does not perform an initial copy of the source volumes when the incremental resync command is invoked, but does copy on all first updates to source tracks since the preceding FlashCopy. Again, this copy only occurs when that track is destaged, so in many cases there is no impact to application performance.

The designer needs to consider the consequences of bursts of background copy, initially and following each resync (COPY option), which might impact the application, versus continuous impact, when there are collisions that require a source to target copy before the write update can complete (NOCOPY option).

If running incremental FlashCopy for an extended period of time, the COPY option could very well be the proper choice.

10.6 FlashCopy scenarios

This section describes four scenarios. These scenario discussions assume that the primary concern is to minimize the FlashCopy impact on application performance.

10.6.1 Scenario #1: Backup to disk

In environments where Recovery Time Objective (that is, how quickly you can return to production after a failure) is of utmost importance, a FlashCopy backup to disk can help to achieve an extremely fast restore time. As soon as the logical FlashCopy is complete, it is possible to perform a reverse FlashCopy and restore your production data in seconds, instead of the several hours it would normally take to retrieve the data from tape.

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When backing up to disk, it is important to take the necessary steps to protect your data. Remember that, until the background copy is complete, you still only have one physical copy of the data, and that copy is vulnerable. Therefore, it is important to always establish the FlashCopy with the COPY option. Otherwise, in the unlikely event you have a failure of your production volumes, you will also lose your backup.

One method for protecting against failure is to use multiple FlashCopy targets. FlashCopy supports up to 12 targets per source volume. With this feature, it is possible to keep up to 12 versions of your production data (for example, a FlashCopy backup every two hours for one day). Another method is to use incremental FlashCopy. Incremental FlashCopy copies only the data that has changed since the last FlashCopy, so the background copy completes much faster.

10.6.2 Scenario #2: Backup to tape

If you want to create a copy of the data only to subsequently back up that data to tape, then FlashCopy with the NOCOPY option is the preferred approach. Still there are some implementations where the COPY option is employed.

The backup to tape is normally done shortly after the *logical* FlashCopy relationships have been established, for all the volumes that are going to be backed up to tape.

If you choose the NOCOPY option, that's probably because the data being backed up to tape is mostly coming from the FlashCopy *source* volumes. If this is the case, then the location of the target volumes is less critical and might be decided by considerations other than performance.

If you choose the COPY option, that's probably because the data being backed up is coming from the target volumes, assuming that the backup to tape does not start until the background copy completes. If the backup starts sooner, the data could be coming from a mixture of source volumes and target volumes. As the backup continues, more and more of the data will come from the target volumes as the background copy moves more and more of the data to the target volumes.

To have the least impact on the application and to have a fast backup to tape, we recommend that the source volumes be evenly spread across the available disk subsystems and the disk subsystem resources. Once the backup to tape is complete, make sure to withdraw the FlashCopy relationship.

Tip: withdraw the pairs as soon as the backup to tape is finished. This eliminates any additional copying from the source volume, either due to COPY or collisions.

These recommendations would be equally valid for a COPY or NOCOPY environment.

10.6.3 Scenario #3: FlashCopy during peak application activity

Tip: The recommended solution is to fully explore alternatives that would allow no overlapping of FlashCopy activity with other peak application activity. If such alternatives are not viable for whatever operative reasons, then consider the topics discussed in the present section.

As discussed previously, the choice of whether to use COPY or NOCOPY depends mostly on business requirements, but with regard to performance, it also depends a great deal on the

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type of workload. This topic has been discussed in 10.4, “FlashCopy impact on applications” on page 115.

Still, in general, NOCOPY is the preferred method, but you should also think about the following considerations when choosing either COPY or NOCOPY:

- Using NOCOPY - The argument here is that the impact caused by the I/O resulting from the COPY option is more significant than that of the NOCOPY option, where less I/O activity resulting from collisions occur. Still, since the background copy only occurs when the writes are destaged from nonvolatile cache, there is typically negligible impact. If the workload is cache friendly, then potentially all of the operations will be served from cache, and there will be no impact from collisions at all.
- Using COPY - The goal of using COPY is to quickly complete the background copy and hence the overlapping situations between FlashCopy and application processing end sooner. If COPY is used, then all I/Os experience some degradation because they compete for resources with the background copy activity. However, this impact may be somewhat less than the impact to the individual writes that a collision causes.

  If FlashCopy NOCOPY is active during a period of high application activity, there could be a high rate of collisions, that is, destages being delayed so that the track image can be read and then written to the FlashCopy target track to preserve the point-in-time copy. The destage delay could cause degradation of the performance for all writes that occur during the delay destage periods. Note that it is only the first write to a track that would cause a collision, and only when that write gets destaged. The reads do not suffer the *collision degradation*.

If using the COPY option, consider also these tips:

- Examine the application environment for the highest activity volumes and the most performance-sensitive volumes.
- Consider arranging the FlashCopy order such that the highest activity and most performance-sensitive volumes are copied early and the least active and least performance-sensitive volumes are copied last.

The intent here is to minimize the potential for collisions.

Tip: One approach to achieve a specified FlashCopy order would be to partition the volumes into priority groups. Issue the appropriate FlashCopy commands for all volumes, but use COPY on only the highest priority group and NOCOPY on all other groups. After a specified period of time or after some observable event, issue FlashCopy commands to the next highest priority group from NOCOPY to COPY. Continue in this manner until all volumes are fully copied.

If a background copy is the desired end result and FlashCopy is to be started just before or during a high-activity period, consider the possibility of starting with NOCOPY and converting to COPY after the high-activity period has completed.

One might also want to examine the use of incremental FlashCopy in a high performance sensitive-activity period. Incremental FlashCopy automatically uses the COPY option, so if the NOCOPY option was previously selected, using incremental FlashCopy may impact performance by causing a full background copy.

If the incremental FlashCopy approach is chosen, it might be best to create a FlashCopy COPY relationship during a quiet time. To minimize the amount of data to be copied when taking the desired point-in-time copy, schedule an incremental refresh sufficiently in advance

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of the point-in-time refresh to complete the copy of the changed data. Finally, take the required point-in-time copy with the incremental refresh at the required point in time.

10.6.4 Scenario #4: Ranks reserved for FlashCopy

Another configuration worth considering is the one where 50% of the ranks (capacity) are all FlashCopy source volumes—and where the application write I/Os take place—and the remaining 50% of the ranks (capacity) are all FlashCopy target volumes.

Such an approach does have pros and cons. The disadvantage is the loss of 50% of the ranks for normal application processing. The advantage is that FlashCopy writes to target volumes will not compete with applications writing to the target volumes. This allows the background copy to complete faster, and thus reduces the interference with application I/Os.

This is a trade-off that must be decided upon:

- Use all ranks for your application
  - Maximize normal application performance.
  - FlashCopy performance is reduced.
- Use only half of the ranks for your applications
  - Maximize FlashCopy performance.
  - Normal performance is reduced.

If planning a FlashCopy implementation at the disaster recovery (DR) site, two distinct environments must be considered:

- DR mirroring performance with and without FlashCopy active
- Application performance if DR failover occurs

The solution should provide acceptable performance for both environments.

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11

FlashCopy examples

This chapter presents examples of the use of FlashCopy in the following scenarios:

- Fast setup of test systems or integration systems
- Fast creation of volume copies for backup purposes

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11.1 Create a test system or integration system

Test systems or integration systems are needed to perform application tests or system integration tests.

As it is assumed that with test systems or integration systems many write operations will occur over the time period involved, we recommend doing a copy in the background environment.

11.1.1 One-time test system

Assume there is an application using one volume, and a test system needs to be created to allow application tests or integration tests based on the contents of the production data. A FlashCopy is set up to copy the data once. See Example 11-1.

The application typically needs to be quiesced or briefly suspended before executing the FlashCopy. Also, some applications cache their data, so this data may need to be flushed to disk, using application methods, prior to running the FlashCopy; this is not covered in our example.

Example 11-1 Create a one-time test system using TSO FlashCopy commands

```
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                               *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3200') TDEVN(X'3400') MODE(COPY)
  FCQUERY DEVN(X'3200')
  FCQUERY DEVN(X'3400')
   /*
```

11.1.2 Multiple setup of a test system with same contents

Assume that an application test is needed multiple times with the same setup of data. The production volume is 3200, the test volume is 3400. Volume 3201 is chosen as an intermediate volume that gets its data once, copying it from the production volume using FlashCopy. Then it is used as base for refresh of the test volume 3400.

Running Part 1 and Part 2 (see Example 11-2 on page 123) as one job would not work. The job would fail, as volume 3201 could not be the target for one FlashCopy relationship and the source for another FlashCopy relationship at the same time. You must wait until the background copy for 3200 and 3201 finishes successfully before starting Part 2.

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Example 11-2 Create a multiple setup of a test system

```
Part 1
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                               *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3200') TDEVN(X'3201') MODE(COPY)
  FCQUERY DEVN(X'3200')
  FCQUERY DEVN(X'3201')
/*
Part 2
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP                               *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3201') TDEVN(X'3400') MODE(COPY)
  FCQUERY DEVN(X'3201')
  FCQUERY DEVN(X'3400')
   /*
```

Whenever the test environment needs to be reset to the original data, just run Part 2 of the job.

11.2 Create a backup

Using FlashCopy for backup purposes can be implemented in several ways, as discussed in the present section.

11.2.1 Create a FlashCopy for backup purposes without volume copy

Volumes that are the result of a FlashCopy can be used by a backup server to back up the data to tape. As the backup process merely reads the data, one option could be to perform a FlashCopy without physically copying all data to the target. As soon as the backup of the data has finished, the FlashCopy relationship could be removed explicitly. The steps involved in this procedure are as follows:

- Part 1: Establish FlashCopy volume A -> volume B with the NOCOPY option.
- Run backup.
- Part 2: Remove the FlashCopy relationship once volume backup has completed.

Example 11-3 and Example 11-4 on page 124 illustrate how to execute the procedure.

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Example 11-3 Create a backup copy using TSO FlashCopy commands

```
Part 1
//*********************************************************************
//*    ESTABLISH FLASHCOPY RELATIONSHIP WITH NOCOPY                   *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3200') TDEVN(X'3400') MODE(NOCOPY)
  FCQUERY DEVN(X'3200')
  FCQUERY DEVN(X'3400')
/*
```

After the backup has been taken, remove the FlashCopy relationship if you don't intend to use it for other purposes. Thus, unnecessary writes can be avoided. See Example 11-4.

Example 11-4 Withdraw the FlashCopy relationship

```
Part 2
//*********************************************************************
//*    WITHDRAW FLASHCOPY RELATIONSHIP                                *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCWITHDR SDEVN(X'3200') TDEVN(X'3400')
  FCQUERY DEVN(X'3200')
  FCQUERY DEVN(X'3400')
/*
```

11.2.2 Incremental FlashCopy for backup purposes

To have the safety of a real physical copy without always copying the full volume is something that can be achieved using the incremental FlashCopy. An initial full volume FlashCopy is followed by subsequent incremental FlashCopies, which only copy the updates that took place on the source volume. See Example 11-5 on page 125.

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Example 11-5 Create a full volume copy with incremental parameter

```
//*********************************************************************
//*    ESTABLISH INCREMENTAL FLASHCOPY RELATIONSHIP                   *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3200') TDEVN(X'3400') INCREMENTAL(YES)
  FCQUERY DEVN(X'3200')
  FCQUERY DEVN(X'3400')
/*
```

After the initial full volume copy, every time you submit the job in Example 11-5, only changed data will be copied to the target FlashCopy volume.

11.2.3 Using a target volume to restore its contents back to the source

Logs may need to be applied to the FlashCopy target volume and then the target volume reversed to the source volume.

To reverse the relationship, the data must have been copied completely to the target before reversing it back to the source. To avoid a situation where the full volume needs to be copied with each FlashCopy, the Incremental FlashCopy should be used. As logs may need to be applied to the target volume prior to reversing it, the target volume should be varied online. This example consists of the following steps:

- Part 1: Establish incremental FlashCopy (MODE(COPY) is a default); see Example 11-6.
- Part 2: Reverse the relationship; see Example 11-7 on page 126.

Applying application or DB logs needs to be carefully considered as well.

Example 11-6 Establish incremental FlashCopy

```
Part 1
//*********************************************************************
//*    ESTABLISH INCREMENTAL FLASHCOPY RELATIONSHIP                   *
//*    SDEVN - SOURCE FLASHCOPY VOLUME                                *
//*    TDEVN - TARGET FLASHCOPY VOLUME                                *
//*********************************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'3200') TDEVN(X'3400') INCREMENTAL(YES)
  FCQUERY DEVN(X'3200')
  FCQUERY DEVN(X'3400')
/*
```

The reverse of the FlashCopy is done using the FCETSTABL command with the ACTION(FRR) parameter. See Example 11-7 on page 126.

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Example 11-7 Reverse the FlashCopy volumes

```
Part 2
//*******************************************************
//*   THIS JOB WILL REVERSE THE DIRECTION OF FLASHCOPY
//*     ORIGINAL SOURCE = 3200, FRR SOURCE = 3400
//*     ORIGINAL TARGET = 3400, FRR TARGET = 3200
//*******************************************************
//STEP1    EXEC PGM=IKJEFT01,REGION=256K
//SYSTSPRT DD  SYSOUT=*
//SYSUADS  DD  DSN=SYS1.UADS,DISP=SHR
//SYSLBC   DD  DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSIN  DD  *
  FCESTABL SDEVN(X'4500') TDEVN(X'3500') ACTION(FRR)
/*
```


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Part 4

Metro Mirror

This part of the book describes IBM System Storage Metro Mirror for DS6000 when used in a System z environment. Here we discuss the characteristics of Metro Mirror and describe the options for its setup. We also show which management interfaces can be used, as well as the important aspects to be considered when establishing a Metro Mirror environment.

This part ends with examples of Metro Mirror management and setup.

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12

Metro Mirror overview

This chapter explains the basic characteristics of Metro Mirror for DS6000 when used in a System z environment.

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12.1 Metro Mirror overview

Metro Mirror (previously known as synchronous Peer-to-Peer Remote Copy, or PPRC) provides real-time mirroring of logical volumes between two DS6000s that can be located up to 300 km from each other. It is a synchronous copy solution where write operations are completed on both copies (local and remote site) before they are considered to be complete.

It is typically used for applications that cannot suffer any data loss in the event of a failure.

As data is synchronously transferred, the distance between primary and secondary disk subsystems will determine the effect on application response time. Figure 12-1 illustrates the sequence of a write update with Metro Mirror.

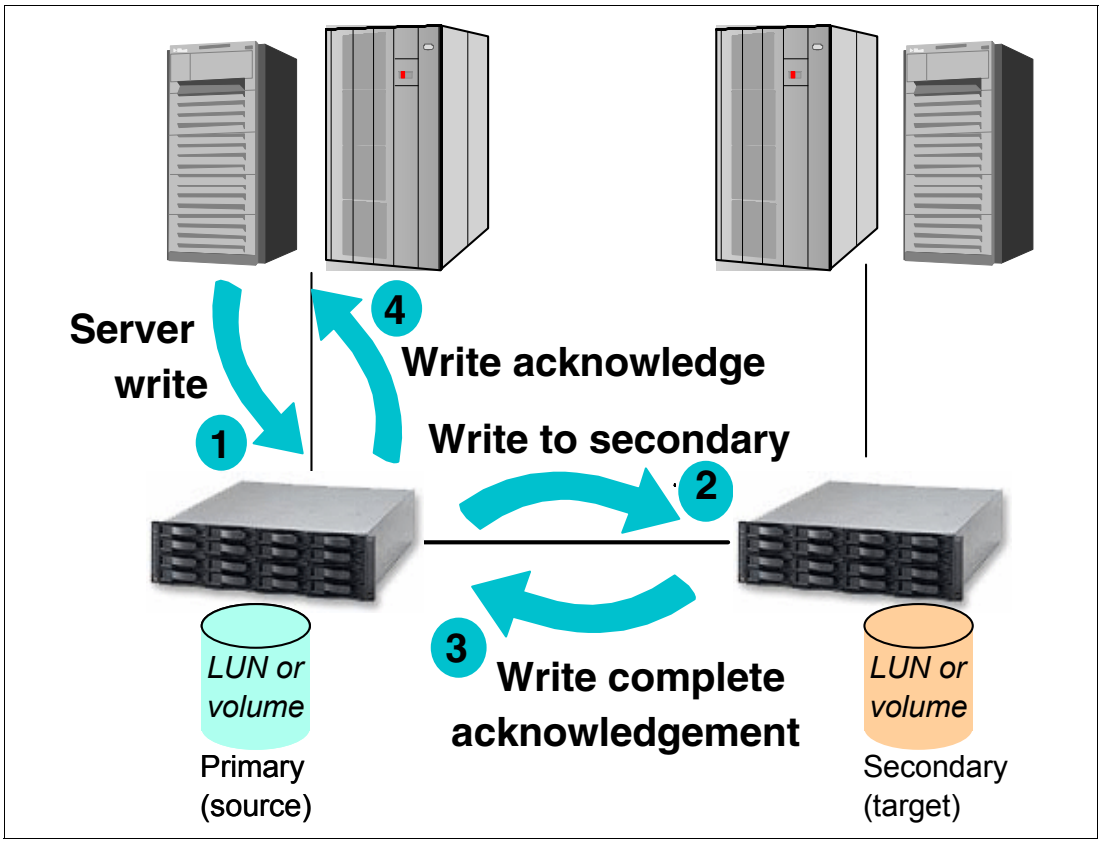

Figure 12-1 Metro Mirror

When the application performs a write update operation to a primary volume, this is what happens:

1. Write to primary volume (DS6000 cache and NVS).
2. Write to secondary volume (DS6000 cache and NVS).
3. Signal write complete from the secondary DS6000.
4. Post I/O complete to host server.

The Fibre Channel connection between primary and secondary subsystems can be direct, through a switch, or through other supported distance solutions (for example, Dense Wave Division Multiplexor, DWDM).

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12.2 Metro Mirror volume state

Volumes participating in a Metro Mirror session can be found in any of the following states:

- Copy pending: volumes are in *copy pending* state after the Metro Mirror relationship is established, but the primary and secondary volumes are still out of sync. In that case, data still needs to be copied from the primary to the secondary volume of the Metro Mirror pair.

  This may be the case immediately after a relationship is initially established, or reestablished after being suspended. The Metro Mirror secondary volume is not accessible when the pair is in copy pending state.
- Full duplex: a volume copy pair is in *full duplex* state when its members are in sync; that is, both primary and secondary volumes contain exactly the same data. The secondary volume is not accessible when the pair is in full duplex.
- Suspended: volumes are in the *suspended* state when the primary and secondary storage subsystems cannot communicate anymore, or when the Metro Mirror pair is suspended manually. In this state, writes to the primary volume are not mirrored onto the secondary volume. The secondary volume becomes out of sync.

  During this time, Metro Mirror keeps a bitmap record of the changed tracks in the primary volume. Later, when the volumes are resynchronized, only the tracks that were updated will be copied.
- Target copy pending: indicates that the primary volume is unknown or cannot be queried and the secondary state is copy pending.
- Target full-duplex: indicates that the primary volume is unknown or cannot be queried and the secondary state is full duplex.
- Target suspended: indicates that the primary volume is unknown or cannot be queried and the secondary state is suspended.
- Not remote copy pair: indicates that the relationship is not a Metro Mirror pair.
- Invalid-state: indicates that the relationship state is invalid.

12.3 Data consistency

In order to restart applications at the remote site successfully, the remote site volumes must have consistent data. In normal operation, Metro Mirror keeps data consistency at the remote site. However, in case of a rolling disaster type of situation, a certain mechanism is necessary to keep data consistency at the remote site.

For Metro Mirror, consistency requirements are managed through use of the *Consistency Group* option. You can specify this option when you are defining Metro Mirror paths between pairs of LSSs or when you change the default LSS settings. Volumes or LUNs that are paired between two LSSs whose paths are defined with the Consistency Group option can be considered part of a Consistency Group.

Consistency is provided by means of the *extended long busy* (for z/OS) or *queue full* (for open systems) conditions. These are triggered when the DS6000 detects a condition where it cannot update the Metro Mirror secondary volume. The volume pair that first detects the error will go into the extended long busy condition, such that it will not do any writes. For z/OS, a system message will be issued (**IEA494I** state change message); for open systems, an SNMP trap message will be issued. These messages can be used as a trigger for automation purposes that will provide data consistency.

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Data consistency, dependent writes, extended long busy, are all discussed in detail in 13.3, “Consistency Group function” on page 136.

Note: Dduring normal Metro Mirror processing, the data on disk at the secondary site is an exact mirror of that at the primary site. During or after an error situation this depends on the options specified for the pair and the path. Remember that any data still in buffers or processor memory is not yet on disk and so will not be mirrored to the secondary site. A disaster will then appear to be a similar situation to a power failure in the primary site.

12.4 Rolling disaster

In disaster situations, it is unlikely that the entire complex will fail at the same moment. Failures tend to be intermittent and gradual, and a disaster can occur over many seconds, even minutes. Because some data may have been processed and other data lost in this transition, data integrity on the secondary volumes is exposed. This situation is called a rolling disaster. The mirrored data at the recovery site must be managed so that cross-volume or LSS data consistency is preserved during the intermittent or gradual failure.

Metro Mirror itself does not offer a means of controlling this scenario. Instead, it offers the *Consistency Group* and *Critical* attributes, which along with appropriate automation solutions, can manage data consistency and integrity at the remote site. The Metro Mirror volume pairs are always consistent, due to the synchronous nature of Metro Mirror; however, cross-volume or LSS data consistency must have an external management method. IBM offers the GDPS® and eRCMF service offerings to deliver solutions in this area; refer to Part 8, “Solutions” on page 431, for more information. You can also visit the IBM Web site and refer to the Services & Industry Solutions page for more information.

12.5 Automation and management

Metro Mirror is a hardware mirroring solution. A volume (or LUN) is paired with a volume (or LUN) in the remote disk subsystem. As the size of the environment grows, so does the complexity of managing it. Therefore, you need a means for managing the pairs, ensuring they are in duplex status, adding volume pairs as required, monitoring for error conditions, and more importantly, for managing data consistency across LSS and across disk subsystems.

When planning a Metro Mirror environment, the following topics should be considered:

- Design of the automation solution
- Maintenance
- Testing
- Support

All these considerations need to be thought about, because you do not want to be in a situation where you are relying on your mirroring implementation for data to be consistent in a disaster situation, only to find that it has not worked, or perhaps worse, you not being aware that your data is not consistent.

IBM offers services and solutions for the automation and management of the Metro Mirror environment, which include GDPS and eRCMF. For more information on GDPS and eRCMF see Part 8, “Solutions” on page 431. You can also visit the IBM Web site and refer to the Services & Industry Solutions page.

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13

Metro Mirror options and configuration

This chapter discusses the options available when using Metro Mirror for DS6000. It also discusses the configuration guidelines that should be considered when planning the Metro Mirror environment.

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13.1 High availability solutions

Because the disk subsystem attached to the server is being mirrored using Metro Mirror, this offers some improved opportunities for high availability solutions.

13.1.1 GDPS HyperSwap Manager

The GDPS services offering includes the GDPS HyperSwap™ Manager function. This function can be used to mask some primary Metro Mirror disk subsystem problems or planned maintenance activities, by allowing the primary DASD to be swapped transparently from one site to another without requiring an application or system outage. For more information, refer to Part 8, “Solutions” on page 431.

13.1.2 Open systems - Clustering

For open system environments, IBM offers several solutions in this area, including GDS for Windows environments, and HACMP™ for AIX. For more information, refer to Part 8, “Solutions” on page 431.

13.2 Failover and failback

The Metro Mirror Failover and Failback modes are designed to help reduce the time required to synchronize Metro Mirror volumes after switching between the production and the recovery sites.

In a typical Metro Mirror environment, processing will temporarily switch over to the Metro Mirror secondary site upon an outage at the primary site. When the primary site is capable of resuming production, processing will switch back from the secondary site to the primary site.

At the recovery site the Metro Mirror Failover function combines, into a single task, the three steps involved in the switch over (planned or unplanned) to the remote site: terminate the original Metro Mirror relationship, then establish and suspend a new relationship at the remote site. Note that the state of the original source volume at the normal production site is preserved. The state of the original target volume at the recovery site becomes a source suspended. This design takes into account that the original source LSS may no longer be reachable.

To initiate the switch back to the production site, the Metro Mirror Failback function at the recovery site checks the preserved state of the original source volume at the production site to determine how much data to copy back. Then either all tracks or only out-of-sync tracks are copied, with the original source volume becoming a target full-duplex. In more detail, this is how Metro Mirror Failback operates:

- If a volume at the production site is in the simplex state, all of the data for that volume is copied back from the recovery site to the production site.
- If a volume at the production site is in the full-duplex or suspended state and without changed tracks, only the modified data on the volume at the recovery site is copied back to the volume at the production site.
- If a volume at the production site is in a suspended state and has tracks that have been updated, then both the tracks changed on the production site and the tracks marked at the recovery site will be copied back.
- Finally, the volume at the production site becomes a write-inhibited target volume. This action is performed on an individual volume basis.

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The switch back is completed with one more sequence of a Metro Mirror Failover followed by a Metro Mirror Failback operations, both given at the now-recovered production site. Figure 13-1 summarizes the process.

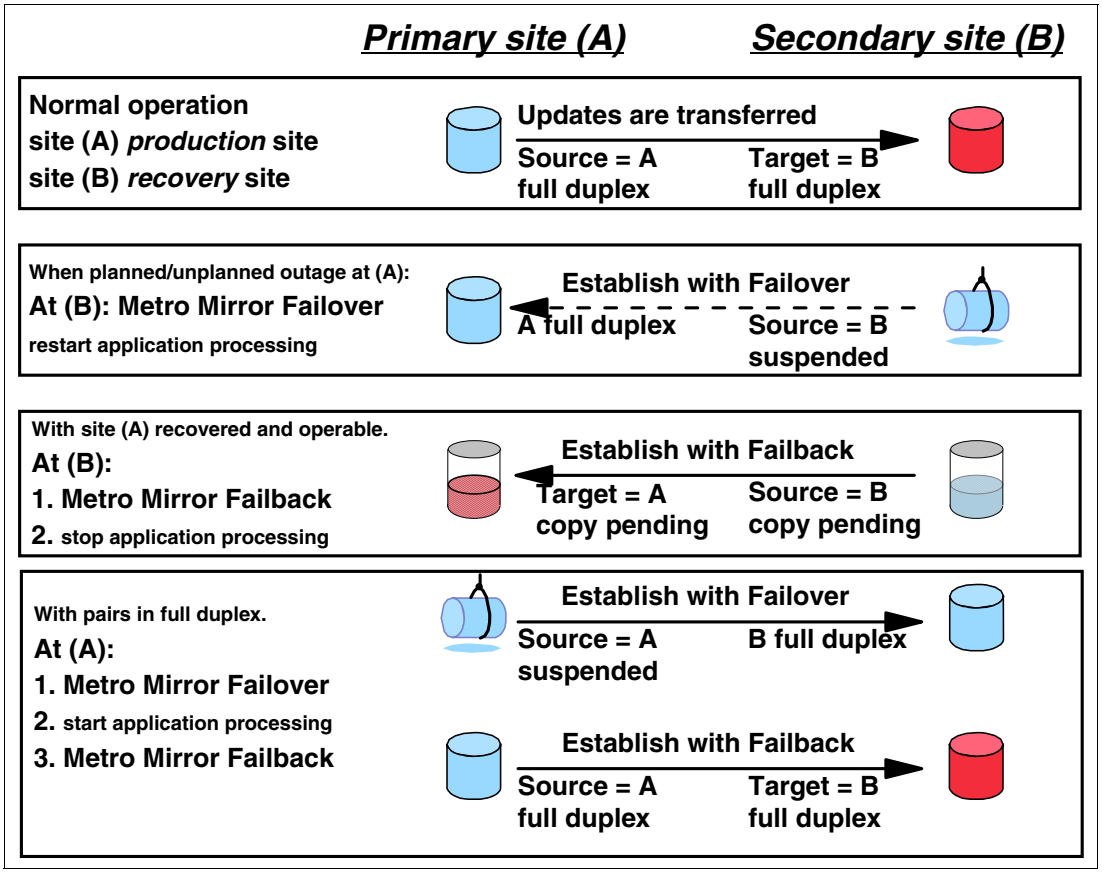

Figure 13-1 Metro Mirror Failover and Failback sequence

In this manner, Metro Mirror Failover and Failback are dual operations. It is possible to implement all site switch operations with two pairs of failover and failback tasks (one pair for each direction).

Note: For a planned switch over from site (A) to site (B), and in order to keep data consistency at (B), the application at site (A) has to be quiesced before the Metro Mirror Failover operation at (B).

Alternatively, you can use the **`freezepprc`** and **`unfreezepprc`** commands. The same consideration applies when switching back from site (B) to (A).

The Metro Mirror Failover and Failback modes can be invoked from the DS Storage Manager GUI, the DS Command-Line Interface (CLI), TSO commands, or using the ICKDSF utility.

We give an example of a Metro Mirror Failover and Failback sequence and how to control it in 16.2, “Failover and failback using TSO” on page 187.

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13.3 Consistency Group function

In order to restart applications at the remote site successfully, the remote site must have consistent data. In normal operation, Metro Mirror keeps data consistency at the remote site. However, as mentioned in 12.3, “Data consistency” on page 131 and in 12.4, “Rolling disaster” on page 132, in case of a rolling disaster, a particular procedure is necessary to keep data consistency even in a synchronous remote copy environment.

In this section we explain *data consistency* and then explain how the Metro Mirror Consistency Group function keeps data consistency at the remote site, in case of a rolling disaster.

13.3.1 Data consistency and dependent writes

Many applications, such as databases, process a repository of data that has been generated over a period of time. Many of these applications require that the repository is in a *consistent* state in order to begin or continue processing. In general, consistency implies that the order of *dependent writes* is preserved in the data copy. In the Metro Mirror environment, keeping data consistency means that the order of dependent writes is preserved in all the Metro Mirror target volumes. For example, the following sequence occurs for a basic database operation involving a log volume and a data volume:

1. Write to log volume: Data Record #2 is being updated.
2. Update Data Record #2 on data volume.
3. Write to log volume: Data Record #2 update complete.

If the copy of the data contains any of these combinations then the data is consistent:

- Operations 1, 2, and 3
- Operations 1 and 2
- Operation 1

If the copy of data contains any of these combinations then the data is *inconsistent* (the order of dependent writes was *not* preserved):

- Operations 2 and 3
- Operations 1 and 3
- Operation 2
- Operation 3

When discussing the Consistency Group function, data consistency means this sequence is always kept in the copied data. And the order of non-dependent writes does not necessarily need to be preserved. For example, consider the following two sequences:

1. Deposit paycheck in checking account A.
2. Withdraw cash from checking account A.
3. Deposit paycheck in checking account B.
4. Withdraw cash from checking account B.

In order for the data to be consistent, the deposit of the paycheck must be applied *before* the withdrawal of cash for each of the checking accounts. However, it does not matter whether the deposit to checking account A or checking account B occurred first, as long as the associated withdrawals are in the correct order. So, for example, the data copy would be consistent if the following sequence occurred at the copy:

1. Deposit paycheck in checking account B.
2. Deposit paycheck in checking account A.
3. Withdraw cash from checking account B.
4. WIthdraw cash from checking account A.

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In other words, the order of updates was not the same as it was for the source data, but the order of *dependent* writes was preserved.

13.3.2 Consistency Group function - how it works

In the operation of the Consistency Group function of Metro Mirror we distinguish two parts. One is the invocation of the Consistency Group option, and the other one is the freeze/run operation. Together, they make it possible for the disk subsystem to *hold* I/O activity and subsequently to *thaw* the held I/O activities.

Consistency Group option

The Consistency Group option causes the disk subsystem to hold I/O activity to a volume for a time period by putting the source volume into a *extended long busy* state when the DS6000 detects a condition where it cannot update the Metro Mirror target volume. This operation can be done across multiple LUNs or volumes, multiple LSSs, and even across multiple disk subsystems. You can specify this option when you are defining Metro Mirror paths between pairs of LSSs, or when you change the default Consistency Group setting on each LSS (the Consistency Group option is disabled by default).

In the disk subsystem itself, each command is managed with each logical subsystem (LSS). This means that there are slight time lags until each volume in the various LSSs is changed to the *extended long busy* state. Some people are concerned that the time lag causes you to lose data consistency, but that is not true. We explain how to keep data consistency in the Consistency Group environments in the following section.

In the example in Figure 13-2, three write operations (first, second, and third) are *dependent writes*. This means that these operations must be completed sequentially.

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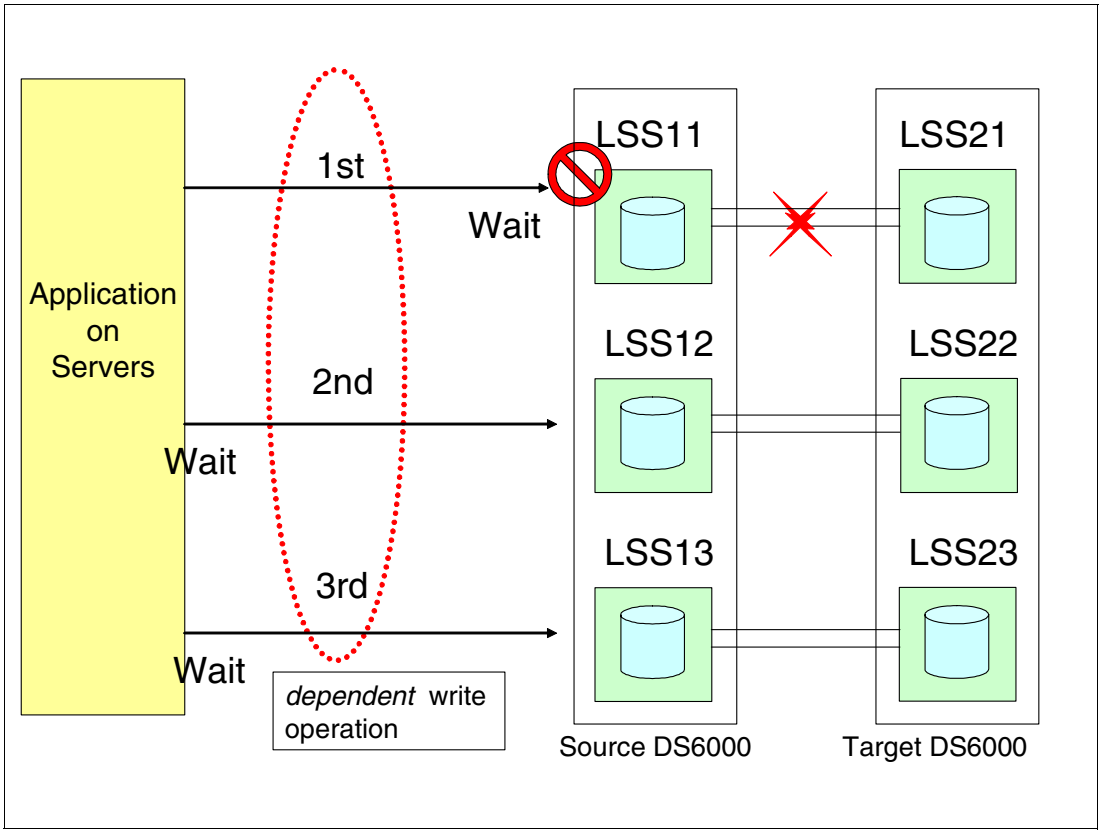

Figure 13-2 Consistency Group: Example 1

In Figure 13-2, there are two Metro Mirror paths between LSS11 and LSS21. There are another two Metro Mirror paths for each of the other LSS pairs (LSS12;LSS22 and LSS13:LSS23). In a disaster, the paths may fail at different times. At the beginning of the disaster, such as a rolling disaster, one set of paths (such as the paths between LSS11 and LSS21) may be inoperable while other paths are working. At this time, the volumes in LSS11 are in an extended long busy condition, and the volumes in LSS12 and 13 are not.

The first operation is not completed because of the extended long busy condition, and the second and third operations are not completed, because the first operation has not been completed. In this case, the first, second, and third updates are not included in the Metro Mirror target volumes in LSS21, LSS22, and LSS23. Therefore, the Metro Mirror target volumes at the remote site keep consistent data.

In the example illustrated in Figure 13-3, the volumes in LSS12 are in an *extended long busy* state and the other volumes in LSS11 and 13 are not. The first write operation is completed because the volumes in LSS11 are not in an extended long busy condition. The second write operation is not completed because of the extended long busy condition. The third write operation is also not completed because the second operation is not completed. In this case, the first update is included in the Metro Mirror target volumes, and the second and third updates are not included. Therefore, this case is also consistent.

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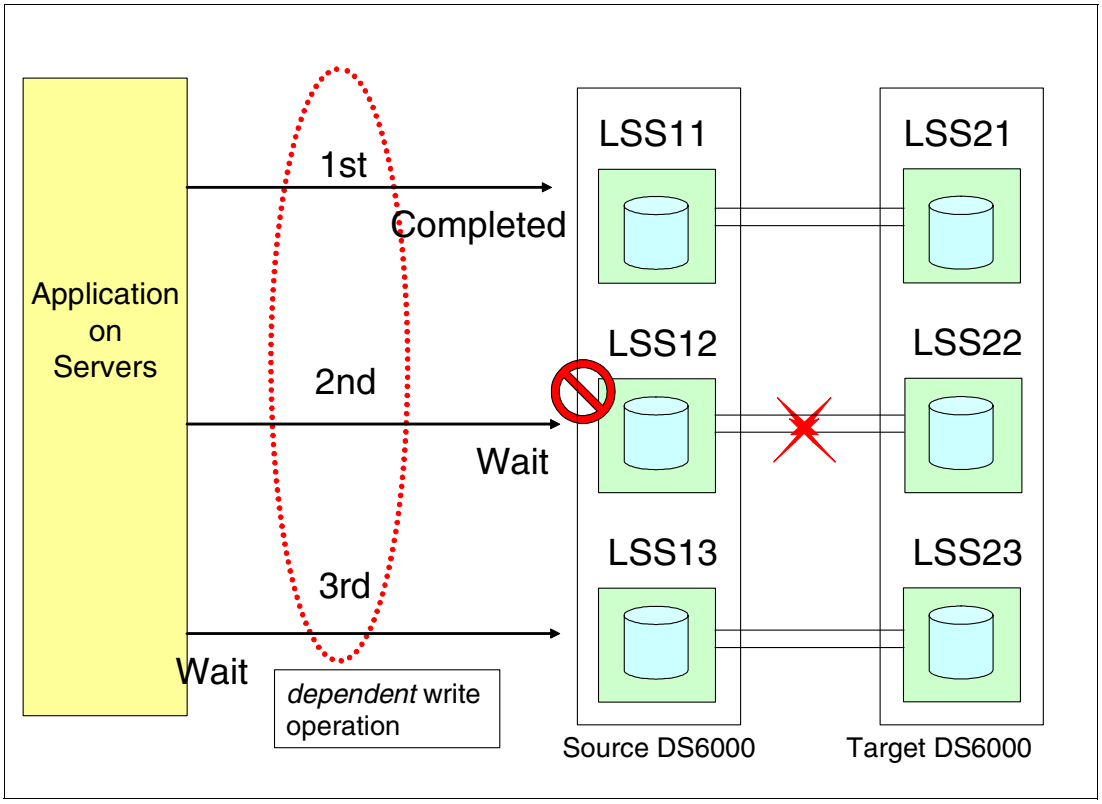

Figure 13-3 Consistency Group: Example 2

In all cases, if each write operation is dependent, the Consistency Group option can keep the data consistent in the Metro Mirror target volumes until the Consistency Group time-out occurs. After the time-out value has been exceeded, all held I/O will be released. The Consistency Group time-out value can be specified at the LSS level.

If each write operation is not dependent, the I/O sequence is not kept in the Metro Mirror target volumes that are in LSSs with the Consistency Group option specified. In the example illustrated in Figure 13-4 on page 140, the three write operations are independent. If the volumes in LSS12 are in an *extended long busy* state and the other volumes in LSS11 and 13 are not, the first and third operations are completed and the second operation is not completed.

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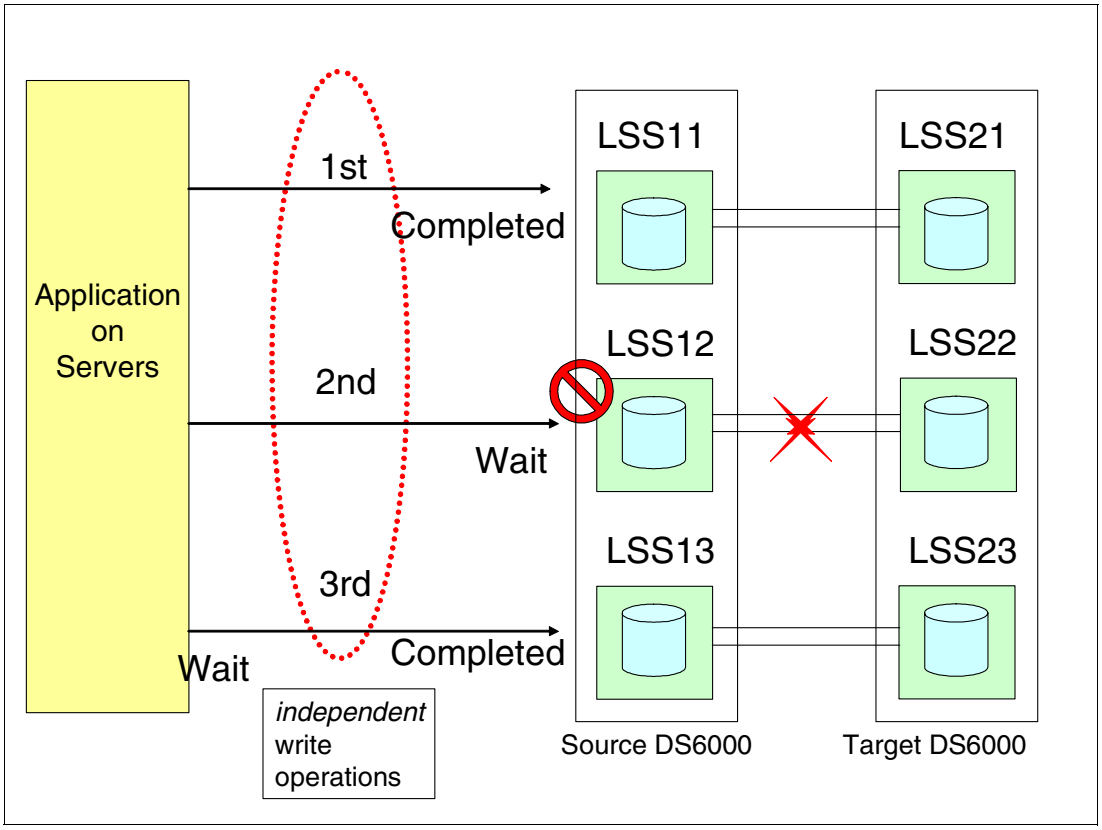

Figure 13-4 Consistency Group: Example 3

In this case, the Metro Mirror target volumes reflect only the first and third write operation, not including the second operation.

Typical database management software can recover its databases by using its log files if *dependent* write operations are kept. At the same time, you should not need to care whether *independent* write operations are kept in sequence.

13.3.3 FREEZE and RUN parameters

Messages and environmental triggers related to Metro Mirror problems can be detected by your automation software. You can then use the TSO command CGROUP with the FREEZE parameter (or equivalent command through the other interfaces) to suspend all required secondary Metro Mirror operations.

The FREEZE option removes the Metro Mirror paths, and suspends the volume pairs for a given LSS pairing. If used in combination with the CGROUP(Y) option of the CESTPATH command, then an *extended long busy* (for z/OS) or *queue full* (for open systems) condition will be forced on all the LSSs where the FREEZE is issued, and thus, all the I/Os to the respective primary volumes will be queued while in the extended long busy window. Once your automation process detects that the updates can be resumed, it can issue the CGROUP command with the RUN parameter. This command releases all I/O to the primary devices, but still leaves the secondary devices suspended at a point-in-time (with the FREEZE the associated paths are removed).

The default 2-minute timer of the extended long busy state gives the automation enough time to issue a CGROUP FREEZE command to the necessary LSSs. I/O resumes after the default 2 minutes if a CGROUP RUN command is not received.

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The ICKDSF PPRCOPY FREEZE and PPRCCOPY RUN commands provide the same functionality as the TSO CGROUP FREEZE and CGROUP RUN commands.

If you are using the DS Command-Line Interface (DS CLI), you can use the **freezepprc** and **unfreezepprc** commands to provide the same functionality as the TSO CGROUP FREEZE and CGROUP RUN commands. It is not possible to issue Consistency Group (freeze/unfreeze) type commands from the DS Storage Manager Graphical User Interface.

Note: In order to re-synchronize your Metro Mirror environment after the problem has been resolved, you will need to redefine your Metro Mirror paths (they are removed as part of the CGROUP FREEZE command). You can then issue CESTPAIR commands with MODE(RESYNC) (or equivalent commands in the other interfaces).

Tip: We recommend using FlashCopy against your secondary volumes prior to a resynchronization. This is because you do not have data consistency until all volumes have reached the Duplex state.

13.3.4 Critical attribute

The critical attribute determines what will happen after a failed I/O to a secondary volume occurs. What happens will depend on how this attribute was set when the pair was established, and how the DS6000 was configured.

The critical attribute is set when establishing the volume pair. If using TSO commands, the CRIT parameter of the CESTPAIR command is used for this. If you are using the DS CLI, the critical attribute is set using the **mkpprc -critmode** parameter. If using ICKDSF, specify the CRIT(YES) parameter of the PPRCOPY ESTPAIR command. If using the DS Storage Manager GUI, select the **Enable critical volume mode** option in the Select copy options page when defining volume pairs.

If CRIT(NO) was specified on the CESTPAIR command (or equivalent options through the other interfaces) when the pairs were established, then following an I/O error completion to the secondary volume, Metro Mirror will suspend the volume and allow subsequent write requests to the Metro Mirror primary volume. The pair is suspended, the secondary volume does not receive any more updates, and the primary DS6000 will perform change recording, thus keeping track of the primary updates for subsequent resynchronization.

If CRIT(YES) was specified with the CESTPAIR command (or equivalent options through the other interfaces), and if an I/O error to the secondary volume occurs, Metro Mirror will either allow or disallow subsequent writes to the primary, depending on how the DS6000 was configured. For z/OS, the `IEA491E` message will present the reason `SUSPENDED, CRITICAL-STATE, ALL WRITES FAILED`. The Metro Mirror pair then remains in a suspended state until the problem is corrected and a CESTPAIR RESYNC or CDELPAIR command is later issued.

Whether subsequent writes to the primary volumes are allowed or not will depend on how the DS6000 LCU is configured:

- DS CLI: **chlcu -critmode enable**
- DS Storage Manager GUI: **Copy Services** → **Paths** → Select **LSS Copy Options** from the pull down list → **Go** → Accept or modify the selected LSSs from the **Select LSS** pull-down list → Select the **Critical Mode** option to enable the setting → **OK**.

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The volume pair is suspended and further writes to the source volume are not accepted if data cannot be sent to the target volume.

13.3.5 Consistency Group and critical mode combination

Table 13-1 shows what happens when the CRIT parameter of the CESTPAIR command, and the CGROUP parameter of CESTPATH command are combined. These options can also be set using the DS CLI, or with the DS Storage Manager GUI.

Table 13-1 Interaction of CRIT and CGROUP parameters

	CRIT(Y)	**CRIT(N)**
CGROUP(Y)	IEA494I with long busy state (SNMP trap for open systems)	IEA494I with long busy state (SNMP trap for open systems)
	Pair in error suspended	Pair in error suspended
	Unit check on primary device	No unit check on primary device
	IEA494I when suspended	IEA494I when suspended
CGROUP(N)	No long busy state	No long busy state
	Pair in error suspended	Pair in error suspended
	Unit check on primary device	No unit check on primary device
	IEA494I when suspended	IEA494I when suspended

The `IEA494I` message with `SUSPENDED` status is issued for the in-error pair to all z/OS images that have the primary volume online. An `IEA491E` message is returned to the issuing system of the next I/O that is attempted to the volume that is suspended. For open systems, an SNMP trap will be issued to the address specified when the DS6000 SNMP service was configured.

For further discussion on the CGROUP and the CRIT parameters, refer to *z/OS DFSMS Advanced Copy Services*, SC35-0428.

13.4 Metro Mirror paths and links

Metro Mirror pairs are set up between volumes in LSSs, usually in different disk subsystems, and these are normally in separate locations. A *path* (or group of paths) needs to be defined between the primary (source) LSS and the secondary (target) LSS. These *logical paths* are defined over *physical links* between the disk subsystems.

The physical link includes the host adapter in the primary DS6000, the cabling, switches or directors, any wideband or long distance transport devices (DWDM, channel extenders, WAN), and the host adapters in the secondary disk subsystem. Physical links can carry multiple Metro Mirror logical paths, as shown in Figure 13-5 on page 143.

Note: For Metro Mirror, the DS6000 supports Fibre Channel links only. To facilitate ease of testing, the DS6000 does support Metro Mirror source and target on the same DS6000.

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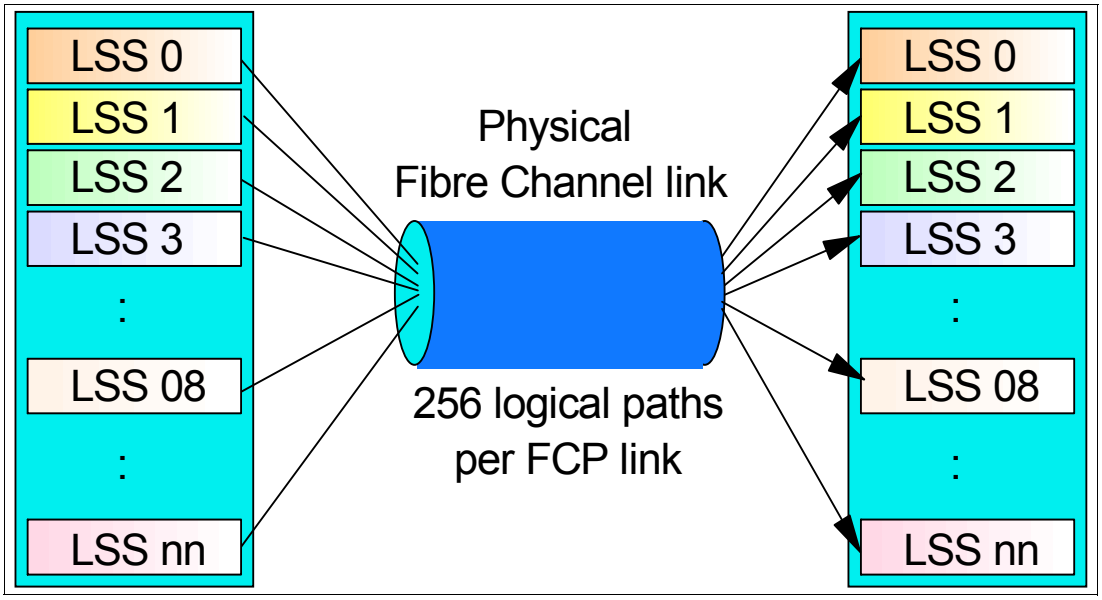

Figure 13-5 Logical paths

Paths are unidirectional, that is they are defined to operate in either one direction or the other. Still, Metro Mirror is bidirectional. That is, any particular pair of LSSs can have paths defined among them that have opposite directions—each LSS holds both source and target volumes from the other LSS. Moreover, opposite direction paths are allowed to be defined on the same Fibre Channel physical link.

For bandwidth and redundancy, more than one path can be created between the same LSSs. Metro Mirror will balance the workload across the available paths between the primary and secondary LSSs.

Note: Keep in mind that the LSS is not a physical construct in the DS6000; it is a logical construct. Volumes in an LSS can come from multiple disk arrays.

Physical links are bidirectional and can be shared by other Metro Mirror pairs, as well as other remote mirror and copy functions, such as Global Copy and Global Mirror.

13.4.1 Fibre Channel links

A DS6000 Fibre Channel port can simultaneously be:

- Sender for Metro Mirror primary.
- Receiver for a Metro Mirror secondary.
- Target for Fibre Channel Protocol (FCP) hosts I/O from open systems and Linux on System z.

Although one FCP link would have sufficient bandwidth for most Metro Mirror environments, for redundancy reasons we recommend configuring two Fibre Channel links between each primary and secondary disk subsystem.

With the DS6000 you have only eight Fibre Channel ports (FC ports) available, four per server (controller). And, each sever owns each FC port, unlike the DS8000. Therefore, we recommend that you use two Fibre Channel links for Metro Mirror, *one on each controller,* for availability and balanced configuration. See Figure 13-6.

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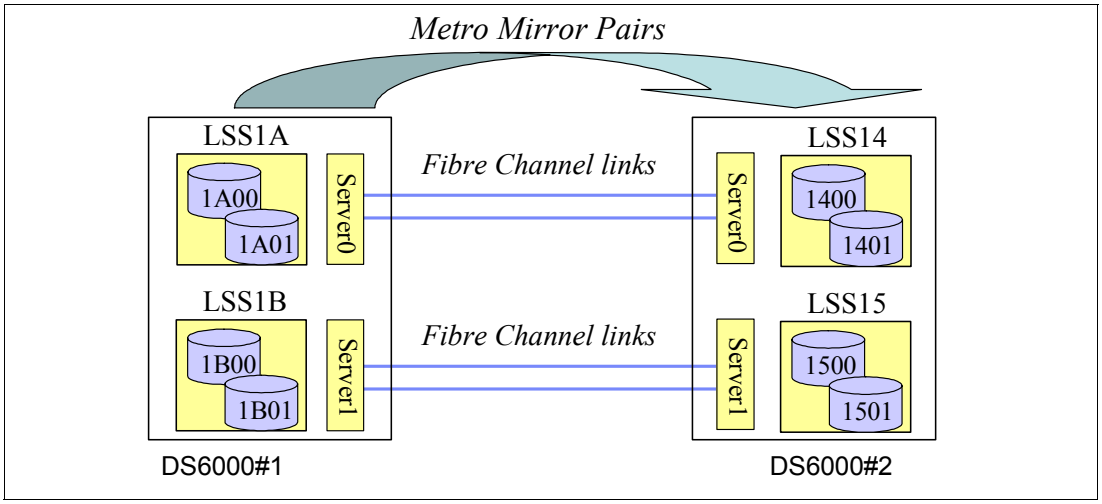

Figure 13-6 DS6000 FC ports

Dedicating Fibre Channel ports for Metro Mirror use guarantees no interference from host I/O activity. This is recommended with Metro Mirror, which is time-critical and should not be impacted by host I/O activity. The Metro Mirror ports used provide connectivity for all LSSs within the DS6000, and can carry multiple logical Metro Mirror paths.

Important: If you want the same set of Fibre Channel links to be shared between Metro Mirror and Global Copy or Global Mirror, consider the impact of the aggregate data transfer. In general, we do not recommend sharing the FCP links used for Metro Mirror, including the physical network links, with other asynchronous remote copy functions.

Metro Mirror FCP links can be direct connected, or connected by up to two switches.

Note: If you use channel extension technology devices for Metro Mirror links, verify with the product's vendor what environment (direct connect or with SAN switch) is supported by the vendor, as well as which SAN switch is supported.

13.4.2 Logical paths

A Metro Mirror logical path is a logical connection between the sending LSS and the receiving LSS. An FCP link can accommodate multiple Metro Mirror logical paths.

Figure 13-7 on page 145 shows an example where we have a 1:1 mapping of source to target LSSs, and where the three logical paths are accommodated in one physical link:

- LSS1 in DS6000 1 to LSS1 in DS6000 2
- LSS2 in DS6000 1 to LSS2 in DS6000 2
- LSS3 in DS6000 1 to LSS3 in DS6000 2

Alternatively, if the volumes in each of the LSSs of DS6000 1 map to volumes in all three secondary LSSs in DS6000 2, there will be nine logical paths over the physical link (not fully illustrated in Figure 13-7). We recommend a 1:1 LSS mapping.

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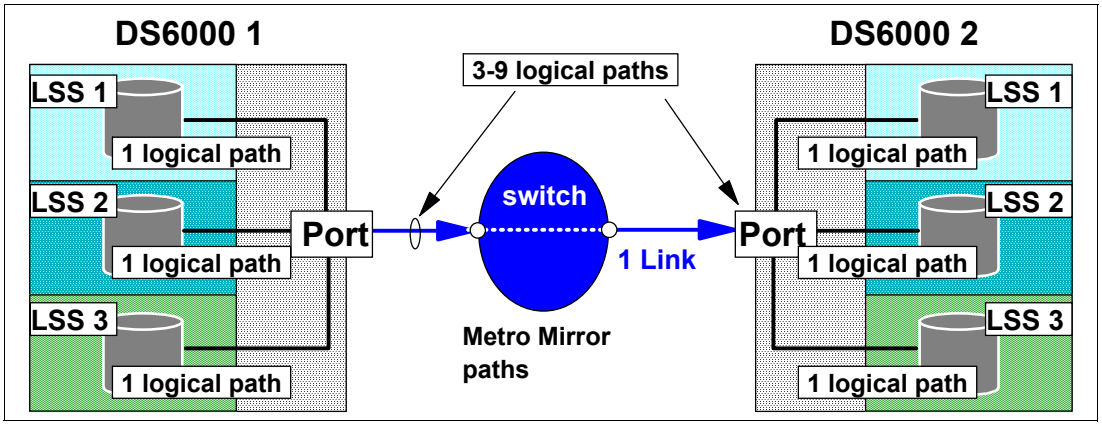

Figure 13-7 Logical paths for Metro Mirror

Metro Mirror paths have certain architectural limits, as follows:

- A primary LSS can maintain paths to a maximum of four secondary LSSs. Each secondary LSS can reside in a separate DS6000.
- Up to eight logical paths per LSS-LSS relationship can be defined, and they will be defined over different physical links.
- An FCP port can host up to 2048 logical paths; these are the logical and directional paths that are made from LSS to LSS.
- An FCP link (the physical connection from one port to another port) can host up to 256 logical paths.
- An FCP port can accommodate up to 126 different links (DS6000 port to DS6000 port through the SAN).

13.5 Bandwidth

Prior to establishing your Metro Mirror solution, establish what your peak bandwidth requirement will be. This will help to ensure that you have enough Metro Mirror links in place to support that requirement.

To avoid any response time issues, establish the peak write rate for your systems and ensure you have adequate bandwidth to cope with this load and allow for growth. Remember that only writes are mirrored across to the secondary volumes.

Tools to assist with this data collection include RMF™ in the z/OS environment.

For more information on bandwidth and available connection options, refer to *IBM TotalStorage Business Continuity Solutions Guide*, SG24-6547.

13.6 LSS design

Because the DS6000 has made the LSS a topological construct, which is not tied to a physical array as in the ESS, the design of your LSS layout can be simplified. It is now possible to assign LSSs to applications, for example, without concern regarding under-allocation or over-allocation of physical disk subsystem resources. This can also simplify the Metro Mirror environment, because it is possible to reduce the number of commands that are required for data consistency.

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13.7 Distance

The distance between your primary and secondary DS6000 subsystems will have an effect on the response time overhead of the Metro Mirror implementation. The maximum supported distance for Metro Mirror is 300 km.

13.8 Symmetrical configuration

When planning your Metro Mirror configuration, consider the possibility of a *symmetrical* configuration, in terms of both physical and logical elements. This will have the following benefits:

- Simplifying management. It is easier to see where volumes will be mirrored, and processes can be easily automated.
- Reducing administrator overhead. Due to automation, and the simpler nature of the solution, overhead can be reduced.
- Simplifying the addition of new capacity into the environment. New arrays can be added in a modular fashion.
- Easing problem diagnosis. The simple structure of the solution will aid in identifying where any problems may exist.

Figure 13-8 shows this idea in a graphical form.

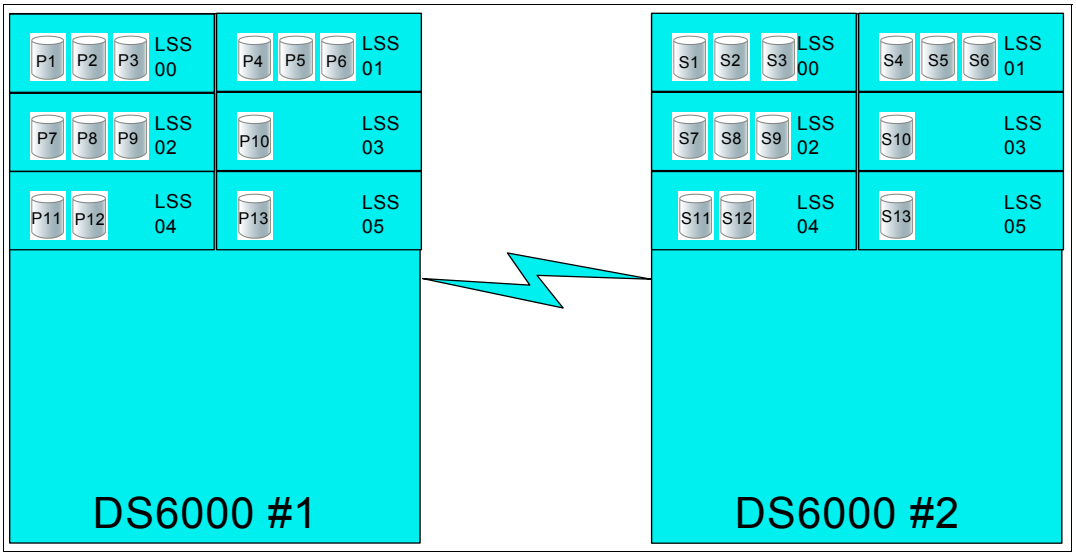

Figure 13-8 Symmetrical Metro Mirror configuration

As shown in Figure 13-8, DS6000 #1 has Metro Mirror paths defined to DS6000 # 2, which is in a remote location. On DS6000 #1, volumes defined in LSS 00 are mirrored to volumes in LSS 00 on DS6000 #2 (volume P1 is paired with volume S1, P2 with S2, P3 with S3, and so on). Volumes in LSS 01 on DS6000 #1 are mirrored to volumes in LSS 01 on DS6000 #2, and so on.

Requirements for additional capacity can be added in a symmetrical way also: by the addition of volumes into existing LSSs, and by the addition of new LSSs when needed (for example, addition of two volumes in LSS 03 and 05, and one volume to LSS 04 will bring them to the same number of volumes as the other LSS). Additional volumes could then be distributed evenly across all LSSs, or additional LSSs could be added.

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In addition to making the maintenance of the Metro Mirror configuration easier, the symmetrical implementation has the added benefit of helping to balance the workload across the DS6000. Figure 13-8 shows a logical configuration, but this idea applies equally to the physical aspects of the DS6000. You should attempt to balance workload and apply symmetrical concepts to other aspects of your DS6000 (for example, the Extent Pools).

13.9 Volumes

You will need to consider which volumes should be mirrored to the secondary site. One option is to mirror all volumes. This is advantageous for the following reasons:

- You will not need to consider whether any required data has been missed.
- Users will not need to remember which logical pool of volumes is mirrored and which is not.
- You will not require a potentially complex volume pooling scheme (DFSMS Storage Groups).
- Addition of volumes to the environment is simplified—you will not have to have two processes for addition of disk (one for mirrored volumes, and another for non-mirrored volumes).
- You will be able to move data around your disk environment easily without worrying about whether the target volume is a mirrored volume or not.

You may choose not to mirror all volumes. In this case you will need careful control over what data is placed on the mirrored volumes (to avoid any capacity issues) and what is placed on the non-mirrored volumes (to avoid missing any required data). One method of doing this could be to place all mirrored volumes in a particular set of LSSs, in which all volumes have Metro Mirror enabled, and direct all data requiring mirroring to these volumes. On z/OS, this could be accomplished using DFSMS Storage Groups and DFSMS Automatic Class Selection routines. Figure 13-9 shows a graphical view of this concept.

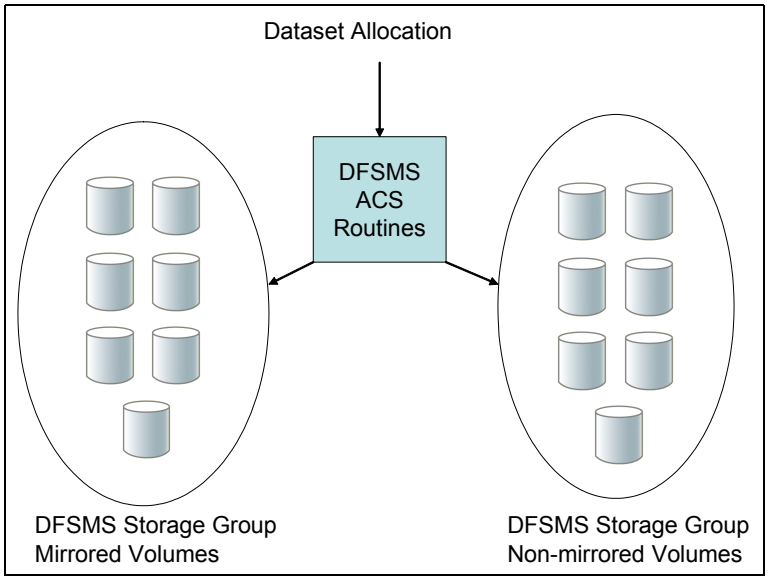

Figure 13-9 DFSMS Storage Group separation

Although mirroring all volumes might be the simplest solution to manage, it could also require significantly more network bandwidth. Because network bandwidth is a cost to the solution, minimizing this bandwidth may well be worth the added management complexity.

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13.10 Hardware requirements

Metro Mirror is an optional licensed function of the IBM System Storage DS6000 series.

All DS6000 series licensed functions are enabled, authorized, managed, activated, and enforced based upon the physical capacity contained in a 1750 system. Particularly for Metro Mirror, the DS6000 must have the Remote Mirror and Copy (RMC) licensed function, with the corresponding feature #531x, based on the physical capacity.

Note: For a detailed explanation of the features involved and the considerations you must have when ordering Metro Mirror, refer to the IBM System Storage DS6000 Series (IBM 1750-522) announcement letter.

IBM announcement letters can be found at:

http://www.ibm.com/products

For additional information on the DS6000 licensed function features, also refer to Appendix C, “Licensing” on page 525.

Interoperability

Metro Mirror pairs can only be established between disk subsystems of the same (or similar) type and features. For example, a DS6000 can have a Metro Mirror pair with another DS6000, a DS8000, an ESS 800, or an ESS 750. It cannot have a Metro Mirror pair with an RVA or an ESS F20.

Note that all disk subsystems must have the appropriate Metro Mirror feature installed. If your DS6000 is being mirrored to an ESS disk subsystem, the ESS must have PPRC Version 2 (which supports Fibre Channel links) with the appropriate licensed internal code level (LIC).

Refer to the DS6000 Interoperability Matrix for more information at:

http://www-1.ibm.com/servers/storage/disk/ds6000/interop.html

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14

Metro Mirror interfaces

This chapter discusses, and provides examples of, the interfaces that can be used for Metro Mirror management, setup and control when used with the IBM System Storage DS6000 in a System z environment.

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14.1 Metro Mirror interfaces - overview

There are various interfaces available for the setup and management of Metro Mirror for DS6000 in a System z environment:

- For z/OS and OS/390, the following interfaces can be used:
  - TSO commands
  - ICKDSF utility
  - ANTRQST application programming interface (API)
  - DS6000 interfaces
- For z/VM:
  - ICKDSF utility
  - DS6000 interfaces
- For VSE:
  - ICKDSF utility
  - DS6000 interfaces
- For TPF:
  - ICKDSF utility
  - TPF itself
  - DS6000 interfaces
  - Other attached servers that support control of Metro Mirror

The following are the DS6000 interfaces that can also be used with the previous list of operating systems:

- DS Command-Line Interface (DS CLI). The DS CLI can be used to invoke Metro Mirror commands from a server that supports the DS CLI (for example, a Windows XP server), provided that the server has appropriate connectivity to the DS6000 DS SMC.
- DS Storage Manager (DS SM) Graphical User Interface (DS SM GUI). The DS SM provides a graphical user interface (GUI) running in a Web browser that communicates with the DS6000 Storage Management Console (DS SMC).
- TotalStorage Productivity Center for Replication (TPC for Replication). The TPC Replication Manager server connects to the same network where the DS SMC is.
- DS Open Application Programming Interface (DS Open API).

This chapter gives an overview of the z/OS interfaces, as well as the DS CLI and the DS SM Graphical User Interface. These interfaces are also covered in Part 2, “Interfaces” on page 15.

TotalStorage Productivity Center for Replication (TPC for Replication) provides management of DS6000 series business continuance solutions, including FlashCopy, Metro Mirror, and Global Mirror. TPC for Replication is covered in Chapter 31, “IBM TotalStorage Productivity Center for Replication” on page 467. TPC for Replication includes similar functions to Global Mirror Utility (GMU). GMU users should consider migrating to TPC for Replication.

The DS Open Application Programming Interface (DS Open API), which is a set of application programming interfaces that are available to be integrated in programs, can also be used for Metro Mirror management and control. Coverage of the DS Open API is beyond the scope of this IBM Redbook. For information on the DS Open API, refer to *IBM System Storage DS Open Application Programming Interface Reference*, GC35-0516.

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Similar functions of the interfaces for Metro Mirror management

Table 14-1 lists the commands and selections for the different interfaces that provide similar Metro Mirror control functions.

Table 14-1 Commands for the different interfaces

Command	TSO	ICKDSF	DS CLI	DS Storage Manager
Establish path	CESTPATH	PPRCOPY ESTPATH	mkpprcpath	Copy services → Paths → Create
Establish pair	CESTPAIR	PPRCOPY ESTPAIR	mkpprc	Copy services → Metro Mirror → Create
Freeze Consistency Group	CGROUP FREEZE	PPRCOPY FREEZE	freezepprc	Not available
Thaw Consistency Group	CGROUP RUN	PPRCOPY RUN	unfreezepprc	Not available
Suspend pair	CSUSPEND	PPRCOPY SUSPEND	pausepprc	Copy services → Metro Mirror → Suspend
Query pair	CQUERY	PPRCOPY QUERY	lspprc	Copy services → Metro Mirror
Query path	CQUERY PATH	PPRCOPY QUERY PATHS	lspprcpath	Copy services → Paths
Recover secondary	CRECOVER	PPRCOPY RECOVER	rmpprc -at src	Copy services → Metro Mirror
Resume suspended pair	CESTPAIR MODE(RESYNC)	PPRCOPY ESTPAIR MODE(RESYNC)	resumepprc	Copy services → Metro Mirror → Resume
Delete pair	CDELPAIR	PPRCOPY DELPAIR	rmpprc	Copy services → Metro Mirror → Delete
Delete path	CDELPATH	PPRCOPY DELPATH	rmpprcpath	Copy services → Paths → Delete
Failover	CESTPAIR ACTION(FAILOVER)	PPRCOPY ESTPAIR FAILOVER	failoverpprc	Copy services → Metro Mirror → Recovery Action
Failback	CESTPAIR ACTION(FAILBACK)	PPRCOPY ESTPAIR FAILBACK	failbackpprc	Copy services → Metro Mirror → Recovery Failback

14.2 TSO commands for Metro Mirror management

For z/OS, the TSO Metro Mirror commands offer a powerful and flexible interface for controlling your Metro Mirror environment. They can also be used to control open systems volumes through the recent addition of support.

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The TSO commands communicate with the DS6000 through a device number specified in the command. IP connectivity is not required.

TSO commands can be integrated into REXX programs for automation purposes.

Tip: if you are controlling open systems volumes with TSO commands, you must have a z/OS volume in the same server to direct your command to. For example, for an open systems LUN in LSS 16, a z/OS volume in LSS 00 can be used for the device address. If you had a LUN in LSS 15, you can use a z/OS volume in LSS 01.

14.2.1 Commands overview

Most TSO commands require the subsystem identifier (SSID) of the LSS to be specified, and some require the channel connection address (CCA) of the volume also.

Channel connection address

Some Metro Mirror TSO commands require the use of the channel connection address (CCA) of the device in question. The CCA on a DS6000 is always relative to the LSS, and is always between **00** and **FF**. If the device numbers on the DS6000 have been generated as a contiguous group of 256 addresses, where each group belongs to an LSS (logical control unit), then the CCAs that are going to be used for the Metro Mirror commands are the last two digits of the device number.

For example, for device numbers `AA00` to `AAFF`, the corresponding CCAs are `00` to `FF`. If you did not define the device addresses contiguously, you can obtain the CCA for a device by using the TSO CQUERY command, or the DEVSERV system command.

Subsystem identifier

During the installation and configuration process, each logical control unit (that is, each LSS) is assigned a unique four-digit subsystem identifier (SSID). This setting is required to identify the control unit for the host for error reporting reasons and also for functions like Metro Mirror.

Each LSS must have a different SSID. The authors recommend assigning consecutive SSID numbers to each LSS in a DS6000. This simplifies the configuration procedure and makes it easier for the subsequent identification of the LSSs. LSSs attached to the same operating system image must have different SSIDs; that is, SSIDs must be *unique*. z/OS checks during the IPL to ensure that there are no duplicate SSIDs.

When establishing Metro Mirror paths, the SSIDs are used in the Metro Mirror TSO commands to identify the primary and secondary LSSs to be paired.

When issuing commands to open systems volumes from TSO commands, you use a special SSID value. You can either use `x'FFFF'`, if you are unsure what the value should be, or check the value using a CQUERY command.

14.2.2 CESTPAIR

This command is used to establish the Metro Mirror primary to secondary relationship. The primary and secondary volumes must have the same number of tracks on each cylinder and the same number of bytes on each track. The secondary device must have the same number, or a greater number, of cylinders than the primary device. If you ever need to swap the Metro Mirror direction, as in a failover/failback, then the volumes must be the same size.

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This command has parameters that allow it to indicate whether the operation is an initial establish of volumes that were in the simplex state, whether it is a resynchronization of a suspended pair of volumes, whether it is a Metro Mirror or Global Copy pair, or whether Failover or Failback processing is being requested.

Example 14-1 shows the command necessary to establish an initial Metro Mirror pair.

Example 14-1 TSO CESTPAIR command

```
ANTP8802I CESTPAIR DEVN(X'6400') PRIM(X'0002' AAVCA X'00' X'00')
   SEC(X'0003' AAVCA X'00' X'01')           OPTION(SYN
ANTP8802I (CONT) C) MODE(COPY) ONLINSEC(NO)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6400. COMPLETION CODE:
00
IEA494I 6400,DS6400,PPRC PAIR PENDING,SSID=0002,CCA=00
IEA494I 6400,DS6400,PPRC PAIR FULL DUPLEX,SSID=0002,CCA=00
```

In Example 14-1, the primary volume resides on LSS x'00' of the application site DS6000. The SSID of the LSS is x'0002', the serial number of the DS6000 is AAVCA, its CCA is x'00', and the LSS is x'00'. The secondary volume resides in LSS x'00' of the recovery site DS6000. Its CCA is x'00'. This matching between the last two digits of the device number address and the CCAs of the primary and the secondary volumes is not mandatory; however, it is useful for working with the configuration. CCA is discussed in "Channel connection address" on page 152.

The MSGREQ(YES) parameter specifies that Metro Mirror wait until the initial full volume copy operation is complete before issuing the completion message ANTP0001I. If you are using automation, use this message as a trigger for other operations.

14.2.3 CESTPATH

When you are establishing a path between DS6000s for Metro Mirror, use the CESTPATH command. There must be a physical Fibre Channel connection between the two DS6000 subsystems. You need to know the SSID, World Wide Node Name (WWNN), and LSS number for the primary and secondary DS6000s. These can be displayed with the CQUERY command.

Example 14-2 shows an example of a CESTPATH command to establish Metro mirror paths.

Example 14-2 CESTPATH command

```
CESTPATH DEVN(X'6400') PRIM(X'0002' 500507630EFFFCA0 X'00') -
        SEC(X'0003' 500507630EFFFCA0 X'01') -
   LINK(X'00000100')           CGROUP(NO)
```

The example shown in Example 14-2 is establishing a loopback path to the same DS6000. The SSID of the primary volume is x'0002', the WWNN is 500507630EFFFCA0, and the LSS is x'00'.

The link address specifies the DS6000 host adapter ports for the Metro Mirror path. The format of each Fibre Channel path address has the hex digit form of 00300200 where:

0000 Specifies the Fibre Channel adapter used for the path in the primary subsystem.

0100 Specifies the Fibre Channel adapter used for the path in the secondary subsystem.

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14.2.4 CDELPAIR

The CDELPAIR command is used to specify the primary and secondary volumes to be removed from a Metro Mirror pairing. This command should be directed to the primary device; see Example 14-3.

Example 14-3 CDELPAIR command

```
CDELPAIR DEVN(X'6400') PRIM(X'0002' AAVCA X'00' X'00') -
   SEC(X'0003' AAVCA X'00' X'01')
```

Before issuing a CDELPAIR command, you should verify that there are some active paths between the respective primary and secondary LSSs. If all of the paths that were established between both LSSs have been disabled, the CDELPAIR command will fail. After the failing CDELPAIR command times out, the state of the primary volume is simplex. The secondary volume remains in its previous state (duplex, pending, or suspended). You then must issue a CRECOVER command to return the secondary volume to the simplex state.

In Example 14-3, the primary volume has SSID x'0002', the serial number is AAVCA, the CCA is x'00', and the LSS is x'00'.

14.2.5 CDELPATH

The CDELPATH command is used to delete established Metro mirror paths between a primary LSS and the corresponding secondary LSS; see Example 14-4. Only the paths to the specified secondary LSS are affected. All other paths to other LSSs are not affected.

Before issuing a CDELPATH command, a CDELPAIR command to all Metro Mirror volume pairs should be issued. The CDELPATH command may cause an ANTP0121I message if this sequence is not followed.

Example 14-4 CDELPATH command

```
CDELPATH DEVN(X'6400') PRIM(X'0002' 500507630EFFFCA0 X'00') -
                     SEC(X'0003' 500507630EFFFCA0 X'01')
```

In Example 14-4, the primary device has SSID x'0002', WWNN 500507630EFFFCA0 and LSS x'00'.

14.2.6 CGROUP

The CGROUP command is used to control operations for multiple Metro Mirror volume pairs on a given LSS:

- **CGROUP FREEZE**

  This command suspends Metro Mirror operations for all Metro Mirror volumes on the specified LSS pair. With the FREEZE parameter, Metro Mirror volume pairs are suspended and Metro Mirror paths are deleted for the specified LSS pair. If the Metro Mirror paths for the LSS pair were defined with Consistency Group enabled (CGROUP parameter of the CESTPATH command), then an extended long busy (ELB) condition is initiated when CGROUP FREEZE is issued for the LSS. During the ELB window, update activity cannot proceed in the LSS where the freeze was done.

- **CGROUP RUN**

  This command resumes all operations for the Metro Mirror volumes on the specified LSS. The CGROUPY RUN command is used in order to reset the ELB condition and release application I/O to the primary volumes.

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Tip: The CGROUP FREEZE command deletes the paths between the specified LSS pair. To restart normal Metro Mirror operation again, the paths will have to be reestablished and the pairs will have to be resynchronized.

Example 14-5 illustrates the CGROUP command.

Example 14-5 CGROUP command example

```
CGROUP DEVN(X'6400') PRIM(X'0002' AAVCA X'00') SEC(X'0003' AAVCA X'01') FREEZE
CGROUP DEVN(X'6400') PRIM(X'0002' AAVCA X'00') SEC(X'0003' AAVCA X'01') RUN
```

The parameters for the CGROUP command follow the usual pattern of SSID, serial number, and LSS.

Note: A single LSS can be paired with up to four other LSSs. Therefore, you might have to issue up to four CGROUP commands to suspend all pairs on a single primary LSS.

14.2.7 CQUERY

The CQUERY command is used to query the status of one volume of a Metro Mirror volume pair or all paths that are associated with the LSS for the device number that is specified. The CQUERY command can be issued to either a primary or secondary Metro Mirror volume. A host system that is attached only to a primary volume cannot obtain the status of the secondary volume for that pair. In the same way, a host attached only to the secondary volume cannot obtain the status of the primary volume.

Example 14-6 shows a CQUERY command for device number 6400.

Example 14-6 CQUERY command

```
CQUERY DEVN(6400)
```

The output of the CQUERY command (shown in Example 14-7) provides volume related information, such as SSID, CCA, LSS number, DS6000 serial number and WWNN.

Example 14-7 CQUERY output

```
ANTP8802I CQUERY DEVN(6400)
ANTP0090I CQUERY FORMATTED LVL 3 739
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                          (PRIMARY)   (SECONDARY) *
*                                         SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6400  PRIMARY..  SUSPEND(3)   ACTIVE..   0002 00 00   0003 00 01 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAVCA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  -------------------                      *
*   1   0000 0100   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH.............                     *
*       ---- ----   00    NO PATH.............                     *
*       ---- ----   00    NO PATH.............                     *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFCA0           5.0.00.0000            *
```


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```
* SECONDARY.1  500507630EFFFCA0                                  *
*****************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6400. COMPLETION CODE: 00
```

Also, from the output information, you can check the number of primary updated tracks, which at that moment were not reflected on the secondary volume (TRACKS OUT OF SYNC); there were none in our example. In addition, you can see the Metro Mirror volume state of the device and how many Metro Mirror paths are established.

The example shown in Example 14-8 shows a CQUERY for an open systems volume.

Example 14-8 CQUERY for open systems volume

```
CQUERY DEVN(6030) ODEVN(AAGXA X'00' X'16') VOLUME
```

In Example 14-9, we show an example of the output from a CQUERY for an open systems volume. Note the SSID value FF16.

Example 14-9 CQUERY output for open systems volume

```
ANTP8802I CQUERY DEVN(6030) ODEVN(AAGXA X'00' X'16') VOLUME
ANTP0090I CQUERY FORMATTED LVL 3 478
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID LUN LSS SSID LUN LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  PENDING...   ACTIVE..   FF16 00 16   FF16 00 16 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  -------------------                     *
*   2   0000 0000   13    PATH ESTABLISHED...                     *
*       0100 0100   13    PATH ESTABLISHED...                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
* IF STATE = PENDING/SUSPEND:    TRACKS OUT OF SYNC =   40523      *
*                                TRACKS ON VOLUME   =   81920      *
*                               PERCENT OF COPY COMPLETE =  51%    *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFC6F           5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                  *
* SECONDARY.2  500507630EFFFCA0                                  *
*****************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
```

14.2.8 CRECOVER

The CRECOVER command is used to allow the recovery system to gain control of the volumes. This command is issued from the recovery system. It signals the recovery DS6000 to force the secondary volume into simplex state, thus allowing the recovery system to gain control of the volume.

During this procedure, the volume serial number can be verified and it can also be relabeled. The volume can be varied online after this command is complete.

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Example 14-10 CRECOVER command

```
CRECOVER DEVN(X'6400') -
PRIM('X0002' AAVCA X'00' X'00') -
SEC(X'0003' AAVCA X'00' X'01') -
ID(VOL002 VOL001) -
MSGREQ(YES)
```

In Example 14-10, the CRECOVER command brings device x'6400' (on the recovery DS6000) to simplex state. It also changes the volume label from VOL002 to VOL001.

14.2.9 CSUSPEND

This command is used to suspend Metro Mirror operations between a volume pair. Metro Mirror stops mirroring data to the secondary volume and starts keeping record of the primary volume tracks that are updated. The information about which tracks were updated while the pair was suspended is used later when the pair is re-established, to copy just the updated tracks.

In Example 14-11, a CSUSPEND command is issued for Metro Mirror primary volume 6400.

Example 14-11 CSUSPEND command

```
CSUSPEND DEVN(X'6400') PRIM(X'0002' AAVCA X'00' X'00') -
   SEC(X'0003' AAVCA X'00' X'01')
```

14.2.10 Batch execution of Metro Mirror TSO commands

Batch procedures can be used to automate the management of Metro Mirror. JCL can be used to issue Metro Mirror commands in batch jobs, and automation procedures can be set to watch for their completion. Automation could analyze the results from previous job executions or Metro Mirror messages, and then schedule other jobs to be executed. Example 14-12 illustrates a batch job for executing a Metro Mirror TSO command.

Example 14-12 Batch job for executing Metro Mirror commands

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP1 EXEC PGM=IKJEFT01
//SYSTSPRT DD SYSOUT=*
//SYSTSIN DD *
   CDELPATH DEVN(X'6400') PRIM(X'0002' 500507630EFFFCA0 X'00') -
                    SEC(X'0003' 500507630EFFFCA0 X'01')
```

14.3 ICKDSF

The System z ICKDSF utility offers a means of control for Metro Mirror functions. ICKDSF typically runs as a batch program, and so can be automatically run from batch scheduling products (for example, Tivoli Workload Scheduler). It also supports VM and VSE systems.

For more information about ICKDSF, refer to *Device Support Facilities User's Guide and Reference*, GC35-0033.

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14.3.1 Metro Mirror management with ICKDSF

Table 14-2 lists the Metro Mirror commands available with ICKDSF.

Table 14-2 ICKDSF Metro Mirror commands

Command	Description
PPRCOPY ESTPATH	Establishes Metro Mirror paths between a primary and secondary LSS
PPRCOPY ESTPAIR	Establishes Metro Mirror volume pairs
PPRCOPY DELPATH	Deletes Metro Mirror paths between a primary and secondary LSS
PPRCOPY RECOVER	Allows a system to regain control of a volume on the secondary DS6000
PPRCOPY SUSPEND	Puts a Metro Mirror pair in the suspended state
PPRCOPY FREEZE	Suspends all Metro Mirror operations at the LSS level
PPRCOPY RUN	Resumes I/O operations after a freeze with Extended Long Busy
PPRCOPY QUERY	Queries the status of Metro Mirror volume pair and path status

All commands have to be addressed to a device that is either online or offline to the system where the job is submitted. For offline volumes, the ICKDSF job must address the volumes directly by specifying `UNITADDRESS`, as shown in Example 14-13.

Example 14-13 Addressing offline volumes

```
//DELPTHRV JOB (ACCT),'DEL REVRSE PPRC PATH',
// CLASS=A,MSGCLASS=H
//STEP01 EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
PPRCOPY DELPATH -
UNITADDR(3000) -
.................
```

Online volumes cannot be addressed directly and DD statements with the volume serial number must be used. This assures access to the volume serial number of the volume, regardless of the real address of the volume; see Example 14-14.

Example 14-14 Addressing online volumes

```
//DELPAIR1 JOB (ACCT),'ICKDSF DELPAIR',
//         MSGCLASS=X,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
//*************************************
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY DELPAIR DDNAME(VOL1) PRI(X'0002',AAVCA,X'00') -
  SEC(X'0003',AAVCA,X'00') LSS(X'00',X'01')
```


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14.3.2 Display the Fibre Channel Connection Information Table

The ANALYZE command allows the user to specify the WWNN of the secondary Metro Mirror volume connected by Fibre Channel links. The analyze pathing reports include the Fibre Channel Connection Information Table. This information indicates the potential connectivity of the Fibre Channel ports in the DS6000 where the I/O is issued to each system adapter port in the DS6000 that is specified by the secondary WWNN.

For example, consider the command shown in Example 14-15.

Example 14-15 ANALYZE NODRIVE NOSCAN command

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6030,DISP=SHR
//SYSIN    DD *
 ANALYZE DDNAME(VOL1) NODRIVE NOSCAN SECWWNN(500507630EFFFCA0)
```

This command in Example 14-15 generates the table seen in Example 14-16 that shows that volume DS6030 with WWNN=500507630EFFFC6F can potentially connect to a device with WWNN=500507630EFFFCA0 from:

- PRI SAID 0000 through secondary SAID 0000 and 0100
- PRI SAID 0100 through secondary SAID 0000 and 0100

Example 14-16 ANALYZE NODRIVE NOSCAN command output

```
FIBRE CHANNEL CONNECTION INFORMATION TABLE
PRIMARY WWNN = 500507630EFFFC6F, SECONDARY WWNN = 500507630EFFFCA0
+------+-------------------------------------------------------------------+
| PRIM |                                                                   |
| SAID |                AVAILABLE SECONDARY SAIDS                          |
+------+-------------------------------------------------------------------+
| 0002 | ----                                                              |
+------+-------------------------------------------------------------------+
| 0102 | ----                                                              |
+------+-------------------------------------------------------------------+
| 0000 | 0000(0000) 0100(0000)                                             |
+------+-------------------------------------------------------------------+
| 0100 | 0000(0000) 0100(0000)                                             |
+------+-------------------------------------------------------------------+
       WHERE THE NUMBER IN PARENTHESIS IS THE RETURN CODE FOR THE SAID, AS FOLLOWS
         0000=POTENTIAL CONNECTION
         0001=NO POTENTIAL CONNECTION
         0002=PRIMARY ADAPTER OFFLINE
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 13:55:57
         0003=LINK FAILURE
         0004=INVALID TOPOLOGY
         0005=ERRORS DETECTED
         0006=SECONDARY WWNN INVALID
         0007=TIMEOUT DETECTED
```

14.3.3 PPRCOPY DELPAIR

The DELPAIR command is used to specify a Metro Mirror pair that will be removed from a Metro Mirror relationship, thus returning the devices to a simplex state. See Example 14-17 on page 160.

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Example 14-17 ICKDSF DELPAIR example

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY DELPAIR DDNAME(VOL1) PRI(X'0002',AAVCA,X'00') -
  SEC(X'0003',AAVCA,X'00') LSS(X'00',X'01')
```

14.3.4 PPRCOPY DELPATH

The DELPATH command is used to delete the defined Metro Mirror paths between a primary LSS and a secondary LSS. Only active paths to the specified recovery site LSS are affected; all other paths to other LSSs are unaffected. Refer to the PPRCOPY ESTPATH command for a description of the link or WWNN parameter.

Example 14-18 ICKDSF DELPATH example

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY DELPATH DDNAME(VOL1) -
  PRI(X'0002',AAVCA) -
  SEC(X'0003',AAVCA) WWNN(500507630EFFFCA0,500507630EFFFCA0) -
  LSS(X'00',X'01')
```

Example 14-18 shows how to specify the PPRCOPY DELPATH command to delete a Metro Mirror path.

14.3.5 PPRCOPY ESTPATH

This command is used to establish paths between the primary and the secondary LSSs. Each ESTPATH command can establish up to eight paths from one application site LSS to a single recovery site LSS.

Example 14-19 ICKDSF ESTPATH

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY ESTPATH DDNAME(VOL1) -
  FCPP(X'00000100') PRI(X'0002',AAVCA) -
  SEC(X'0003',AAVCA) WWNN(500507630EFFFCA0,500507630EFFFCA0) -
  CGROUP(NO) LSS(X'00',X'01')
```

In Example 14-19, the FCPP parameter specifies up to 8 paths, where each path is an eight-digit hexadecimal address in the form X'aaaabbbb' and:

'aaaa' is the primary system adapter ID (SAID).

'bbbb' is the secondary system adapter ID (SAID).

WWNN(X'pwwnn',X'swwnn')

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This specifies the World Wide Node Name of the primary and secondary DS6000. Each WWNN is an 8-byte hexadecimal value X'wwwwwwwwwwwwwwww' where X'pwwnn' represents the primary WWNN and X'swwnn' represents the secondary WWNN.

14.3.6 PPRCOPY ESTPAIR

The ESTPAIR command is used to establish a Metro Mirror relationship between a primary and a secondary volume. Example 14-20 shows the PPRCOPY ESTPAIR command.

Example 14-20 ICKDSF ESTPAIR example

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY ESTPAIR DDNAME(VOL1) PRI(X'0002',AAVCA,X'00') -
  SEC(X'0003',AAVCA,X'00') MODE(COPY) MSGREQ(NO) OPTION(SYNC) -
  CRIT(NO) LSS(X'00',X'01')
```

FAILOVER and FAILBACK are optional parameters of the PPRCOPY ESTPAIR command. A sample failover and failback procedure is discussed in 16.2, “Failover and failback using TSO” on page 187.

14.3.7 PPRCOPY FREEZE

The PPRCOPY FREEZE command suspends operations for the Metro Mirror volumes on a given LSS pair. It is issued to control operations for multiple Metro Mirror volume pairs on the specified LSS pair. With the FREEZE command, Metro Mirror volume pairs are suspended and Metro Mirror paths are deleted.

Example 14-21 shows an example of a PPRCOPY FREEZE command.

Example 14-21 PPRCOPY FREEZE example

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF,TIME=30 ,PARM='NOREPLYU'
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY FREEZE DDNAME(VOL1) PRI(X'0002',AAVCA) SEC(X'0003',AAVCA) -
  LSS(X'00',X'01')
```

Note: When a Metro Mirror path has been established with the CGROUP(YES) parameter, issuing PPRCOPY FREEZE puts devices for that LSS pairing into extended long busy until a PPRCOPY RUN command is issued, or the timeout window (default two minutes) expires.

14.3.8 PPRCOPY QUERY

The QUERY command is used to query the Metro Mirror status of a volume and the associated Metro Mirror paths. A query can be issued to either a primary or secondary Metro Mirror volume.

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A host system that is attached only to a primary volume cannot obtain the status of the secondary volume for that pair. In the same way, a host that is attached only to the secondary volume cannot obtain the status of the primary volume.

Example 14-22 shows an example of the PPRCOPY QUERY command.

Example 14-22 ICKDSF QUERY command

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF,TIME=30 ,PARM='NOREPLYU'
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY QUERY DDNAME(VOL1)
 PPRCOPY QUERY DDNAME(VOL1) PATHS
```

Example 14-23 shows the output from the PPRCOPY QUERY command.

Example 14-23 PPRCOPY QUERY output

```
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 17:48:02

 PPRCOPY QUERY DDNAME(VOL1)                                            00070000
ICK00700I DEVICE INFORMATION FOR 6400 IS CURRENTLY AS FOLLOWS:
          PHYSICAL DEVICE = 3390
          STORAGE CONTROLLER = 1750
          STORAGE CONTROL DESCRIPTOR = E8
          DEVICE DESCRIPTOR = 0A
          ADDITIONAL DEVICE INFORMATION = 4800243D
          TRKS/CYL = 15, # PRIMARY CYLS = 3339
ICK04029I DEVICE IS IN SUSPENDED PPRC STATE

                  QUERY REMOTE COPY - VOLUME

                                                (PRIMARY)    (SECONDARY)
                                                SSID    CCA  SSID    CCA
DEVICE  LEVEL      STATE           PATH STATUS  SER #   LSS  SER #   LSS
------  ---------  --------------  -----------  ----------  ----------
6400    PRIMARY    SUSPEND(3)      ACTIVE       0002    00   0003    00
                                                AAVCA   00   AAVCA   01

PATHS  SAID/DEST               STATUS  DESCRIPTION
-----  ---------               ------  ----------------
1      0000 0100               13      ESTABLISHED FIBRE CHANNEL PATH

IF PENDING/SUSPEND: COUNT OF TRACKS REMAINING TO BE COPIED = 0

ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 17:48:02
ICK02206I PPRCOPY QUERY FUNCTION COMPLETED SUCCESSFULLY
ICK00001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
          17:48:02    06/07/05

 PPRCOPY QUERY DDNAME(VOL1) PATHS                                      00071000
ICK00700I DEVICE INFORMATION FOR 6400 IS CURRENTLY AS FOLLOWS:
          PHYSICAL DEVICE = 3390
          STORAGE CONTROLLER = 1750
          STORAGE CONTROL DESCRIPTOR = E8
          DEVICE DESCRIPTOR = 0A
ADDITIONAL DEVICE INFORMATION = 4800243D
          TRKS/CYL = 15, # PRIMARY CYLS = 3339
```


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```
ICKO4029I DEVICE IS IN SUSPENDED PPRC STATE

                        QUERY REMOTE COPY - PATHS

       PRIMARY CONTROL UNIT INFORMATION

            SERIAL                 WORLD WIDE
            NUMBER   SSID  LSS     NODE NAME
            -------  ----  ---  ----------------
            AAVCA    0002  00   500507630EFFFCA0
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 17:48:02


       SECONDARY CONTROL UNIT INFORMATION

            SERIAL                 WORLD WIDE
            NUMBER   SSID  LSS     NODE NAME
            -------  ----  ---  ----------------
            AAVCA    0003  01


       PATHS:
            SERIAL                 WORLD WIDE
            NUMBER   SSID  LSS     NODE NAME      PATH  SAID  DEST  S*
            -------  ----  ---  ----------------  ----  ----  ----  --
       1ST: AAVCA    0003  01   500507630EFFFCA0    1   0000  0100  13
       2ND: .......  ....  ...  ................  ....  ....  ....  00
       3RD: .......  ....  ...  ................  ....  ....  ....  00
       4TH: .......  ....  ...  ................  ....  ....  ....  00

       S*=PATH STATUS
         00=NO PATH
         01=ESTABLISHED
         02=INIT FAILED
         03=TIME OUT
         04=NO RESOURCES AT PRI
05=NO RESOURCES AT SEC
         06=SERIAL# MISMATCH
         07=SCU SSID MISMATCH
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 17:48:02
         08=ESCON LINK IS OFFLINE
         09=ESTABLISH FAILED BUT WILL RETRY AGAIN WHEN CONDITIONS CHANGE
         0A=SYSTEM ADAPTER HAS A HOST PATH ALREADY ESTABLISHED
         0B=PATH CANNOT BE CONNECTED IN THE SAME CLUSTER
         10=CONFIGURATION ERROR
         11=CANNOT ESTABLISH PATH BETWEEN CKD AND FBA
         12=LSS AND LINKADDRESS MISCOMPARE
         13=ESTABLISHED FIBRE CHANNEL PATH
         14=FIBRE CHANNEL PATH LINK DOWN
         15=FIBRE CHANNEL PATH RETRY EXCEEDED
         16=FIBRE CHANNEL PATH SECONDARY ADAPTER NOT PPRC CAPABLE
         17=FIBRE CHANNEL PATH SECONDARY ADAPTER NOT AVAILABLE
         18=FIBRE CHANNEL PATH PRIMARY LOGIN EXCEEDED
         19=FIBRE CHANNEL PATH SECONDARY LOGIN EXCEEDED

ICKO2206I PPRCOPY QUERY FUNCTION COMPLETED SUCCESSFULLY
ICKO0001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
          17:48:02    06/07/05
```


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```
ICK00002I ICKDSF PROCESSING COMPLETE. MAXIMUM CONDITION CODE WAS 0
```

14.3.9 PPRCOPY RECOVER

The RECOVER command is used to allow the recovery system to regain control of a DASD volume. This command is issued from the recovery system. It signals the recovery site DS6000 to remove the volume from the Metro Mirror relationship (the volume becomes simplex), and thus gives the volume control back to the recovery system. During this process the volser can be verified and also the volume can be relabeled.

14.3.10 PPRCOPY SUSPEND

The SUSPEND command is used to suspend Metro Mirror mirroring between a primary and the corresponding secondary volume. When the SUSPEND command is directed to the primary or secondary device of a Metro Mirror volume pair, the pair is suspended, and data is no longer mirrored onto the secondary volume. At the same time Metro Mirror starts tracking the primary volume tracks that are updated while the pair is suspended. This way, when the pair is reestablished with the PPRCOPY ESTPAIR command, the MODE(RESYNC) option can be used to copy only the updated tracks to synchronize the volumes again. An example is shown in Example 14-24.

Example 14-24 PPRCOPY SUSPEND command

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=DS6400,DISP=SHR
//SYSIN    DD *
 PPRCOPY SUSPEND DDNAME(VOL1) PRI(X'0002',AAVCA,X'00') -
  SEC(X'0003',AAVCA,X'00') LSS(X'00',X'01')
```

14.3.11 PPRCOPY RUN

The PPRCOPY RUN command resumes operations for the Metro Mirror volumes on a given LSS pair. If an extended long busy (ELB) condition was triggered by a previous FREEZE command, then the PPRCOPY RUN command can be used to reset the ELB condition and resume the I/O updates on the primary LSS volumes.

14.3.12 Refreshing the VTOC

If the secondary volume has more cylinders than the primary, the VTOC must be rebuilt to reflect the size of the volume before starting to use it. Example 14-25 illustrates an example of an ICKDSF batch job used for this purpose.

Example 14-25 ICKDSF VTOC Refresh

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP1 EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//DD1 DD DISP=SHR,UNIT=3390,VOL=SER=VOL001
//SYSIN DD *
REFORMAT DDNAME(DD1) VERIFY(VOL001) REFVTOC
/*
```


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Note: In order to run the job to refresh the VTOC of the secondary volume, the Metro Mirror volume pair must first be deleted.

14.4 DS Command-Line Interface

Although the DS CLI will not run on a System z processor, it can be used to perform operations on mainframe disks if you have a supported server environment (for example, Windows XP). The DS CLI can be used to create scripts for setup and control of DS6000 functions. It is a flexible and powerful interface. The DS CLI commands are documented in *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922.

14.4.1 DS CLI supported environments

The DS CLI is supported on the operating systems listed below, at the time of writing:

- AIX
- HP-UX
- HP Tru64
- Linux
- Novell Netware
- OpenVMS
- OS/400®, i5/OS
- Sun Solaris
- Windows

For the most current list of DS CLI supported environments, refer to the interoperability matrix, which is found at the IBM Products site at:

`http://www-03.ibm.com/servers/storage/disk/ds6000/interop.html`

14.5 DS CLI command- examples

In this section we cover the most frequently used DS CLI commands in a Metro Mirror environment, and provide examples of their usage. For most of these commands, you must know some (or all) of the following information:

- The serial number and device type of the source and target DS6000, identified by the **-dev** and **-remotedev** parameters.
  - One way to get the serial number and device type is to use the **lssi** command.
  - The serial number and device type will have the format `IBM.1750-1300247`, for example.

  Note: Many of the examples that are presented here omit the **-dev** and **-remotedev** parameters because we specify them in the DS CLI profile. Using the profile can save a significant amount of typing.

- The WWNN of the remote DS6000, identified by the **-remotewwnn** parameter. The WWNN is also available using the **lssi** command.
- The LSS numbers where the source and target volumes are.
  - The **lslss** command displays all of the LSSs on the system.
  - For a particular volume, the first two digits of the volume number represents the LSS. For example, volume `D000` is located in LSS `D0`.
  - LSS numbers are two-digit hexadecimal numbers.

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- The port IDs for source and target. Up to eight port pair IDs can be specified.
  - The **lsioport** lists the ports on the system.
  - A port ID will have the format I0102, for example.

14.5.1 Set up a Metro Mirror environment

This section gives examples of the commands you can use to set up a Metro Mirror environment. This includes the commands needed to set up the Metro Mirror paths, as well as the commands needed to create the Metro Mirror relationships.

lsavailpprcport

The **lsavailppcport** command is used to display the disk subsystems I/O ports that are available for defining the remote mirroring paths. Example 14-26 shows an **lsavailpprcport** command.

Example 14-26 lsavailpprcport command

```
dscli> lsavailpprcport -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 -remotewwnn
500507630EFE028F 06:01
Date/Time: 23 November 2005 23:37:43 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
Local Port Attached Port Type
=============================
I0003      I0003         FCP
I0103      I0102         FCP
```

In this example, the following parameters are specified:

-dev	the source DS6000, which includes manufacturer, type, and serial number
-remotedev	the target DS6000, which includes manufacturer, type, and serial number
-remotewwnn	the WWNN of the target device
06:01	the source and target LSSs

mkpprcpath

The **mkpprcpath** command is used to establish Metro Mirror paths between LSS pairs on DS6000 subsystems. You can also use this command to replace existing paths. Using the **-consistgrp** parameter with this command, you create Consistency Groups.

Example 14-27 shows a **mkpprcpath** command with two paths being defined.

Example 14-27 mkpprcpath command

```
dscli> mkpprcpath -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 -remotewwnn
500507630EFE028F -srclss 06 -tgtlss 01 I0003:I0003 I0103:I0102
Date/Time: 23 November 2005 23:42:23 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00149I mkpprcpath: Remote Mirror and Copy path 06:01 successfully established.
```

In Example 14-27, the following parameters are specified:

-dev	the source DS6000, specifies the source storage image ID, which includes manufacturer, type, and serial number
-remotedev	the target DS6000, specifies the target storage image ID, which includes manufacturer, type, and serial number
-remotewwnn	the WWNN of the target device
-srclss	the LSS number of the source

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-tgtlss	the LSS number of the target
I0003:I0003	one of the source and target port ID pairs

mkpprc

The **mkpprc** command establishes a Metro mirror volume pair. Example 14-28 illustrates how it is used.

Example 14-28 mkpprc command

```
dscli> mkpprc -remotedev IBM.1750-1300819 -type mmir -mode full 0600:0100 0601:0101
Date/Time: 23 November 2005 23:46:02 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0600:0100 successfully created.
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0601:0101 successfully created.
```

We have specified the **-type mmir** and **-mode full** parameters in this example to establish a Metro Mirror pair, and to do a full copy of the volume. Note that the volume pair is specified at the end of the command.

14.5.2 Remove a Metro Mirror environment

This section describes the commands you can use to remove a Metro Mirror environment.

rmpprc

The **rmpprc** command is used to delete a Metro Mirror volume pair. Example 14-29 shows an example of its use. Note that we are required to confirm that we want to delete this volume pair. We can use the **-quiet** parameter to suppress this confirmation request.

Example 14-29 rmpprc command

```
dscli> rmpprc -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 0601:0101
Date/Time: 24 November 2005 0:01:05 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00160W rmpprc: Are you sure you want to delete the Remote Mirror and Copy volume pair
relationship 0601:0101:? [y/n]: y
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 0601:0101 relationship successfully withdrawn.
dscli>
```

rmpprcpath

The **rmpprcpath** command is used to remove (delete) Metro Mirror paths. An example is shown in Example 14-30.

Example 14-30 rmpprcpath command

```
dscli> rmpprcpath -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 06:01
Date/Time: 24 November 2005 0:02:14 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00152W rmpprcpath: Are you sure you want to remove the Remote Mirror and Copy path
06:01:? [y/n]:y
CMUC00150I rmpprcpath: Remote Mirror and Copy path 06:01 successfully removed.
dscli>
```

Important: the **rmpprcpath** command removes all Metro Mirror paths between the pair of LSSs specified. It is not possible to delete a particular path from a group of paths with this command. You should use the **mkpprcpath** to redefine the paths and omit the path you want to remove.

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14.5.3 Manage a Metro Mirror environment

This section describes the commands you can use to manage a Metro Mirror environment. This includes the commands to manage Metro Mirror relationships and Consistency Groups, as well as commands to display information about Metro Mirror relationships and paths.

freezepprc

The **freezepprc** command is used to remove Metro Mirror paths and suspend volume pairs between a pair of LSSs, and is usually used to provide data consistency. If the Metro Mirror paths were established with the **-consistgrp** parameter, then the volumes enter the extended long busy state when this command is issued. Example 14-31 shows the command. Note that the LSS pair is specified at the end of the command.

Example 14-31 freezepprc command

```
dscli> freezepprc -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 06:01
Date/Time: 23 November 2005 23:47:08 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00161W freezepprc: Remote Mirror and Copy consistency group 06:01 successfully created.
dscli>
```

unfreezepprc

The **unfreezepprc** command is used to take an LSS out of the extended long busy condition after a **freezepprc** command has been issued. Example 14-32 shows how it can be used.

Example 14-32 unfreezepprc command

```
dscli> unfreezepprc -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 06:01
Date/Time: 23 November 2005 23:47:38 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00198I unfreezepprc: Remote Mirror and Copy pair 06:01 successfully thawed.
```

pausepprc

The **pausepprc** command is used to pause (or suspend) a Metro Mirror volume pair. Any updates to the source volume are tracked so that the pair can be resumed at a later time, with only modified tracks having to be sent across to the secondary volume. Example 14-33 shows the command.

Example 14-33 pausepprc command

```
dscli> pausepprc -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 0601:0101
Date/Time: 23 November 2005 23:57:34 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00157I pausepprc: Remote Mirror and Copy volume pair 0601:0101 relationship
successfully paused.
dscli>
```

resumepprc

The **resumepprc** command is used to resume a paused (suspended) Metro Mirror volume pair. Example 14-34 shows how it can be used. Note that we used the **-wait** parameter, which indicates that we want to wait for the volume pair to reach duplex state before receiving a confirmation message.

Example 14-34 resumepprc command

```
dscli> resumepprc -dev IBM.1750-1300247 -remotedev IBM.1750-1300819 -type mmir -wait 0601:0101
Date/Time: 23 November 2005 23:59:50 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00158I resumepprc: Remote Mirror and Copy volume pair 0601:0101 relationship
successfully resumed. This message is being returned before the copy completes.
```


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```
1/1 pair 0601:0101 state: Full Duplex.
```

failoverpprc

The **failoverpprc** command is used to start a failover operation. It changes a secondary device into a primary suspended device while leaving the primary device in its current state. This command succeeds even if the paths are down and the volume at the production site is unavailable or nonexistent. Example 14-35 shows how it can be used for multiple volume pairs. We issued this command to the device at the backup site (which in all previous commands was referred to as the remotedev). We also reversed the volumes, since the former targets are now becoming source volumes.

Example 14-35 failoverpprc command

```
Following command issued to SMC at backup site
dscli> failoverpprc -dev IBM.1750-1300819 -remotedev IBM.1750-1300247 -type mmir 0100:0600
0101:0601
Date/Time: 24 November 2005 0:23:03 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300819
CMUC00196I failoverpprc: Remote Mirror and Copy pair 0100:0600 successfully reversed.
CMUC00196I failoverpprc: Remote Mirror and Copy pair 0101:0601 successfully reversed.

Following command issued to SMC at backup site
dscli> lspprc -dev IBM.1750-1300819 0100-0101
Date/Time: 24 November 2005 0:25:14 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300819
ID        State     Reason      Type         SourceLSS Timeout (secs) Critical Mode First
=========================================================================================
0100:0600 Suspended Host Source Metro Mirror 01        unknown        Disabled      Invalid
0101:0601 Suspended Host Source Metro Mirror 01        unknown        Disabled      Invalid

Following command issued to SMC at production site
dscli> lspprc -dev IBM.13-00247 0600-0601
Date/Time: 24 November 2005 0:26:21 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
ID        State       Reason Type         SourceLSS Timeout (secs) Critical Mode First Pass
=============================================================================================
0600:0100 Full Duplex -      Metro Mirror 06        unknown        Disabled      Invalid
0601:0101 Full Duplex -      Metro Mirror 06        unknown        Disabled      Invalid
```

failbackpprc

The **failbackpprc** command can be issued against any remote mirror and copy volume that is in a primary suspended state. The command copies the required data from the source volume to the target volume to resume mirroring. The command is usually used after a **failoverpprc** command has been issued to restart mirroring either in the reverse direction (recovery site to production site) or original direction (production site to recovery site). However, this command also works if the target volume has been made simplex or is a secondary volume. The command performs a full or partial copy as required.

Example 14-36 on page 171 shows the use of this command. We again issued this command to the machine at the backup site. In the end, the host updates that are generated on the volumes at the backup site are mirrored to the production site. After issuing these commands, and getting into a full duplex state, we could do the failover and failback again in reverse. This would restore the production site disk subsystem to being the source and the backup site disk subsystem to being the target.

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Important: If you failback so that updates are copied from the remote disk subsystem to the local disk subsystem (in other words, from the backup site to the production site), then you must have the corresponding remote copy paths established from the remote site to the local site. If you do not have these paths defined, the command fails.

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Example 14-36 failbackpprc command

```
Following command issued to SMC at backup site
dscli> failbackpprc -dev IBM.1750-1300819 -remotedev IBM.1750-1300247 -type mmir 0100:0600
0101:0601
Date/Time: 24 November 2005 0:39:55 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300819
CMUC00197I failbackpprc: Remote Mirror and Copy pair 0100:0600 successfully failed back.
CMUC00197I failbackpprc: Remote Mirror and Copy pair 0101:0601 successfully failed back.

Following command issued to SMC at backup site
dscli> lspprc 0100-0101
Date/Time: 24 November 2005 0:42:01 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300819
ID        State       Reason Type         SourceLSS Timeout (secs) Critical Mode First Pass
==============================================================================================
0100:0600 Full Duplex -      Metro Mirror 01        unknown        Disabled      Invalid
0101:0601 Full Duplex -      Metro Mirror 01        unknown        Disabled      Invalid

Following command issued to SMC at production site
dscli> lspprc 0600-0601
Date/Time: 24 November 2005 0:40:53 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
ID        State              Reason Type         SourceLSS Timeout (secs) Critical Mode
First Pass Status
==============================================================================================
0100:0600 Target Full Duplex -      Metro Mirror 01        unknown        Disabled
0101:0601 Target Full Duplex -      Metro Mirror 01        unknown        Disabled
```

lspprc

The **lspprc** command is used to list the status of a Metro Mirror pair. Example 14-37 shows a sample of the command.

Example 14-37 lspprc command

```
dscli> lspprc -dev IBM.1750-1300247 0601
Date/Time: 23 November 2005 23:58:17 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
ID        State     Reason      Type         SourceLSS Timeout (secs) Critical Mode First
Pass Status
==============================================================================================
0601:0101 Suspended Host Source Metro Mirror 06        unknown        Disabled      Invalid
dscli>
```

lspprcpath

The **lspprcpath** command is used to display the status of a Metro Mirror path. Example 14-38 shows how it can be used.

Example 14-38 lspprcpath command

```
dscli> lspprcpath -dev IBM.1750-1300247 06
Date/Time: 23 November 2005 23:55:09 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
Src Tgt State   SS   Port  Attached Port Tgt WWNN
============================================================
06  01  Success 2471 I0003 I0003         500507630EFE028F
06  01  Success 2471 I0103 I0102         500507630EFE028F
dscli>
```


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14.6 DS Storage Manager GUI

The DS Storage Manager (DS SM) is a graphical user interface (GUI) that can be used to set up and control Metro Mirror for DS6000 functions. It is user friendly; however, you cannot use it for automation activities, and certain remote mirror and copy functions are not supported from this interface.

The DS Storage Manager interface is simpler to use, however, it is usually slower than the other interfaces, and you cannot save actions for later use. In this section, we give some examples of common tasks that are done using the DS SM.

Our examples use a single DS GUI to manage two DS6000s, each in a different Storage Complex. This means that we have added the remote Storage Complex to the local Storage Complex using the process described in 3.5.1, “Procedure to add a Storage Complex” on page 23.

14.6.1 Define Metro Mirror paths

To establish Metro Mirror paths from the GUI, you can follow the process below. Figure 14-1 shows the Copy services Paths panel. To define paths from LSS 06 of DS6000 serial number 00247 to LSS 01 of DS6000 serial number 00819, we go to the Select Action menu, then select **Create**.

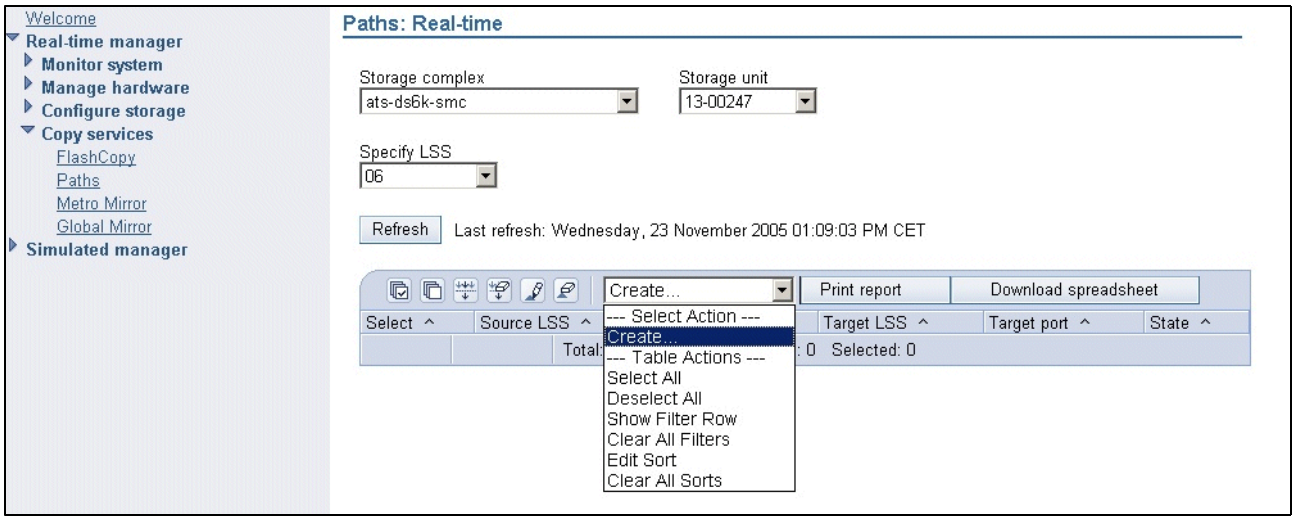

Figure 14-1 Copy services Paths panel

We are then taken to the panel for selecting the source LSS (see Figure 14-2 on page 173). In this panel, in the Select LSS menu we select **06**, and then click **Next**.

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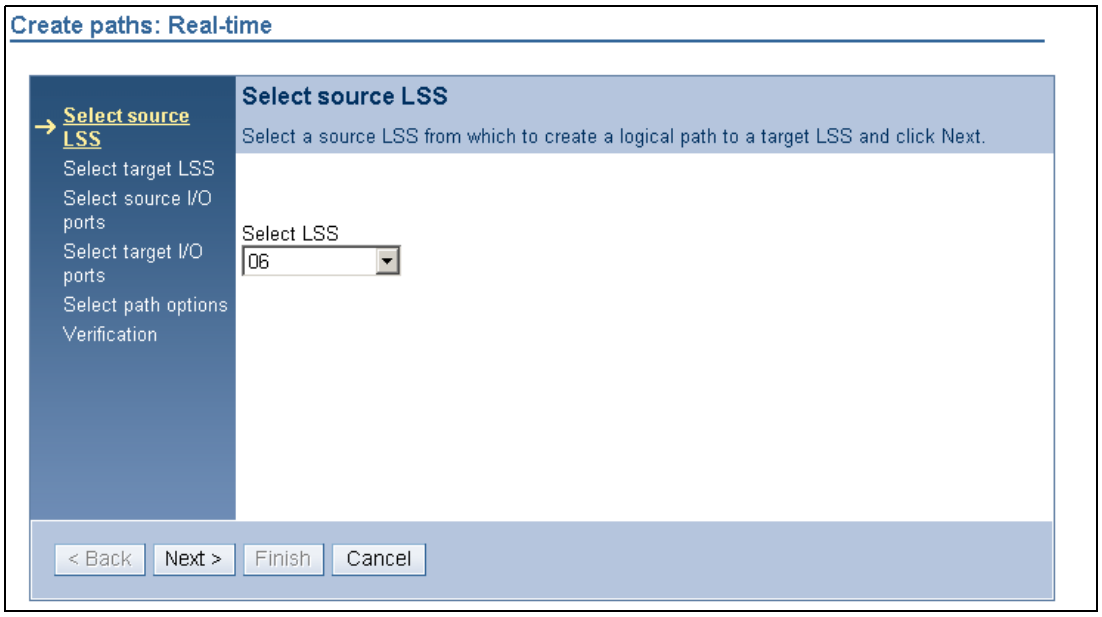

Figure 14-2 Select source LSS panel

Now you must select the target LSS, using the panel shown in Figure 14-3. From the menus provided, select the device to which you want to establish the path. In this example, we chose LSS **01** on a different DS6000. Then click **Next**.

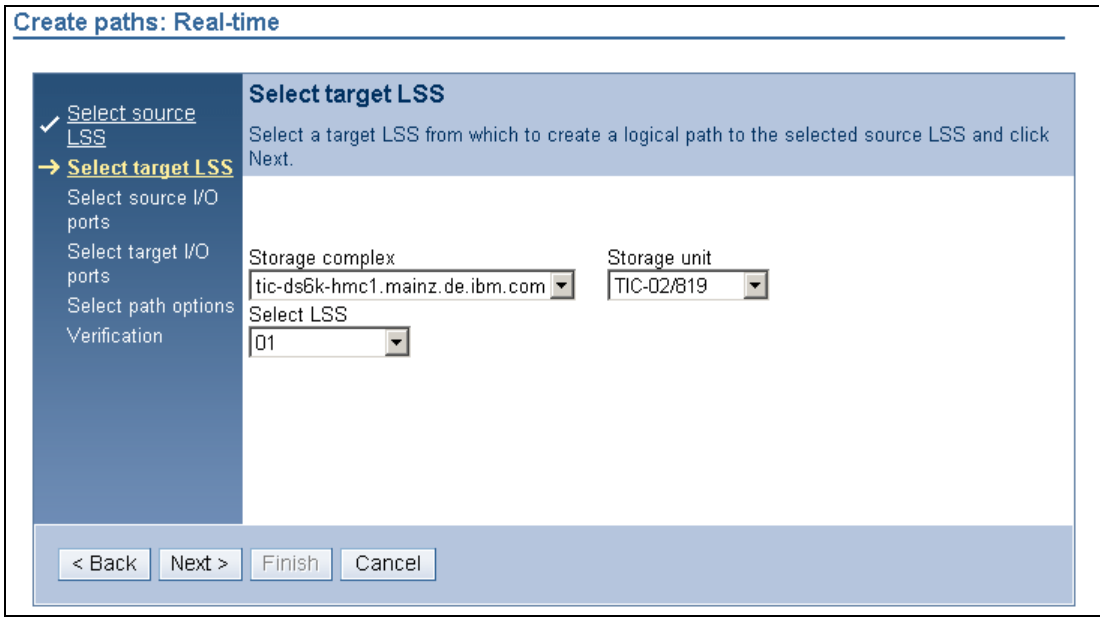

Figure 14-3 Select target LSS panel

Next, you select the source I/O ports, using the panel shown in Figure 14-4 on page 174. Use the check boxes to select the I/O ports you want to use for the Metro Mirror paths that you are establishing. Click **Next**.

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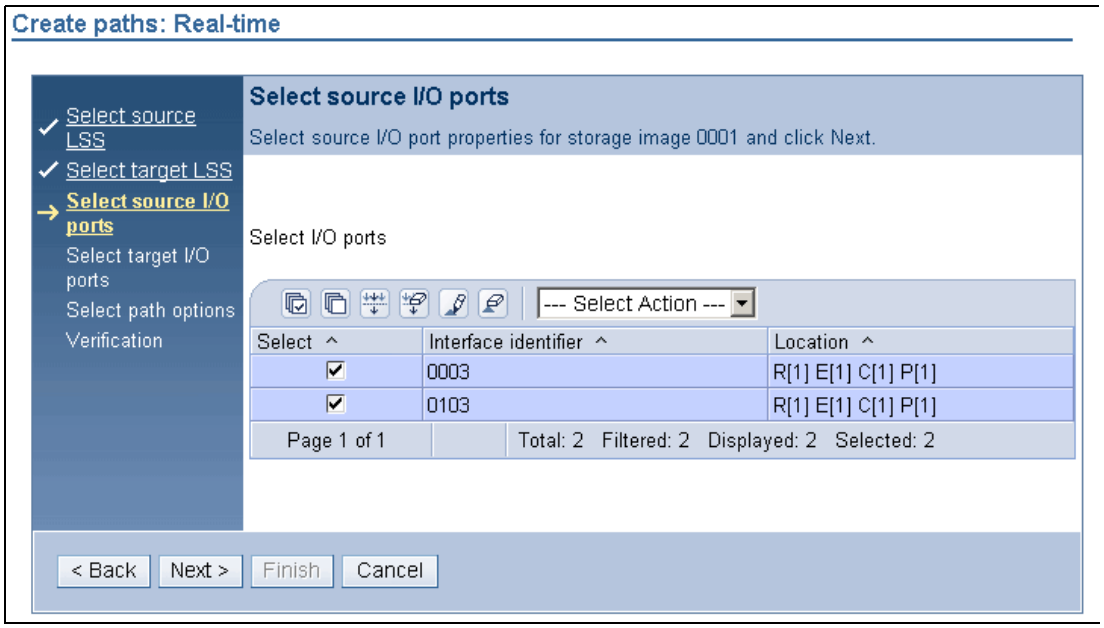

Figure 14-4 Select source I/O ports

Now you must define a target I/O port for each source port. In the example shown in Figure 14-5, there are no selections; however, for your setup you might see menus. Click **Next**.

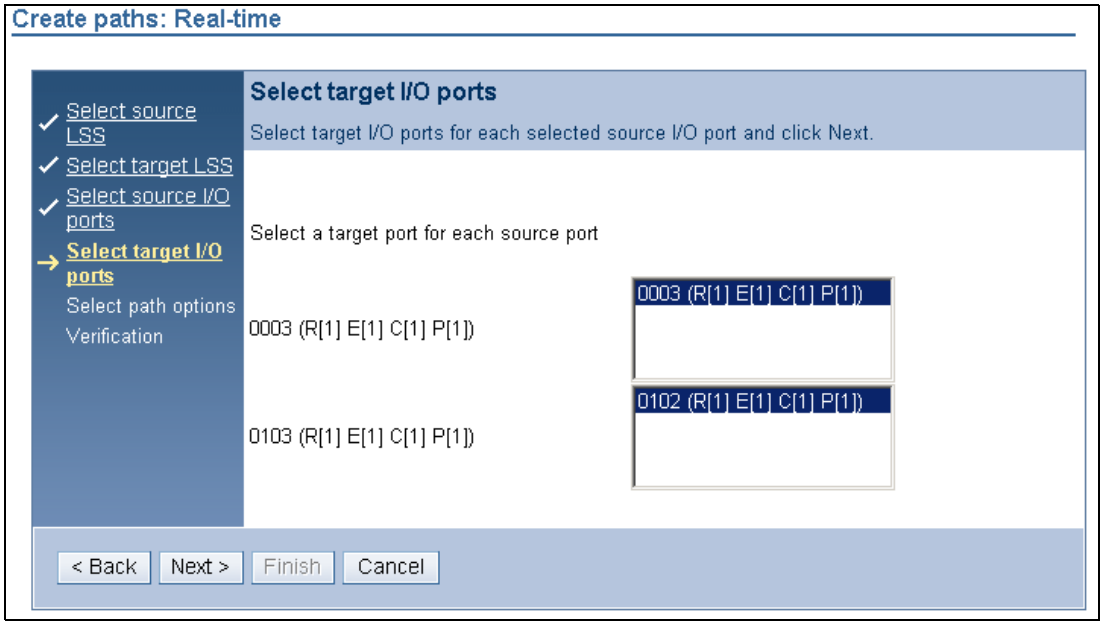
Create paths: Real-time
Select source LSS
Select target LSS
Select source I/O ports
Select target I/O ports
Select path options
Verification
Select target I/O ports
Select target I/O ports for each selected source I/O port and click Next.
Select a target port for each source port
0003 (R[1] E[1] C[1] P[1])
0103 (R[1] E[1] C[1] P[1])
0003 (R[1] E[1] C[1] P[1])
0102 (R[1] E[1] C[1] P[1])
< Back
Next >
Finish
Cancel

Figure 14-5 Select target I/O ports

Next, the panel shown in Figure 14-6 on page 175 opens. Here you can indicate whether the paths will be a Consistency Group path by using the check box. Click **Next**.

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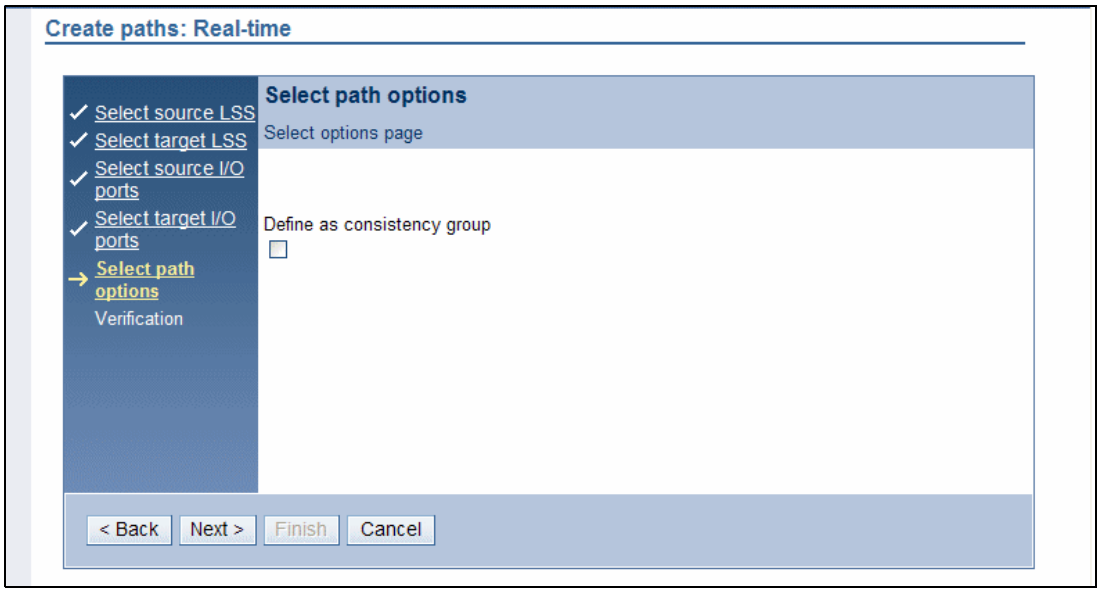

Figure 14-6 Select path options panel

Next, the verification panel (see Figure 14-7) opens. Here you can verify that everything has been selected correctly. If so, click **Finish**. If not, click **Back** or **Cancel** as appropriate.

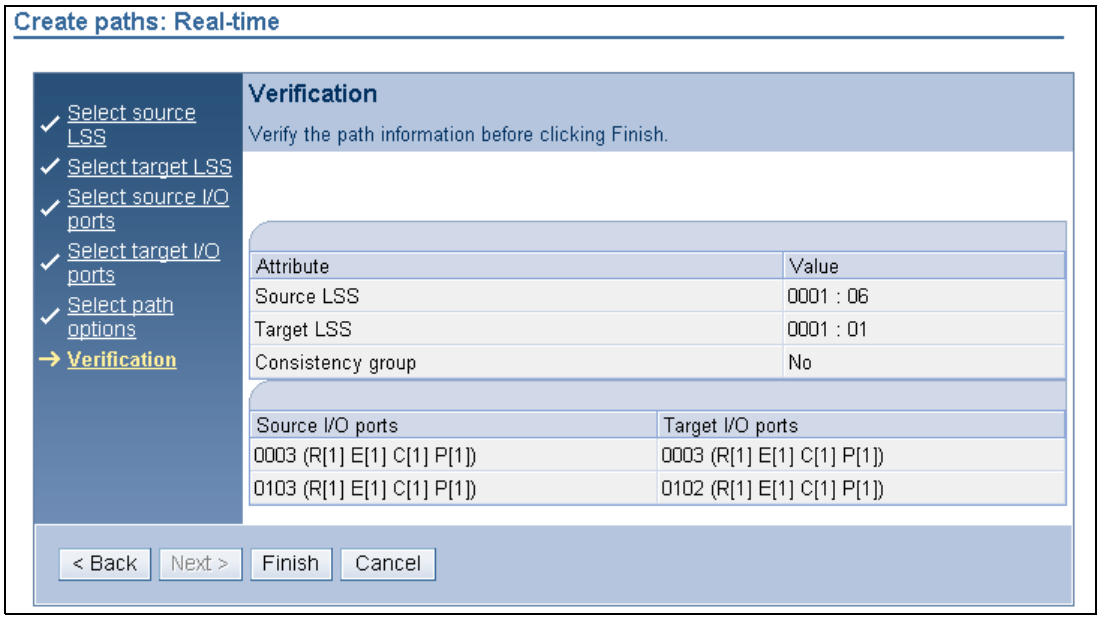

Figure 14-7 Create paths verification panel

14.6.2 Create Metro Mirror pairs

To establish a Metro Mirror pair from the GUI, you can follow the process below. Figure 14-8 on page 176 shows the Metro Mirror panel where we have selected the Metro Mirror source Storage complex, Storage unit, the Resource type (LSS), and the LSS. We then select **Create** from the Select Action pull-down menu.

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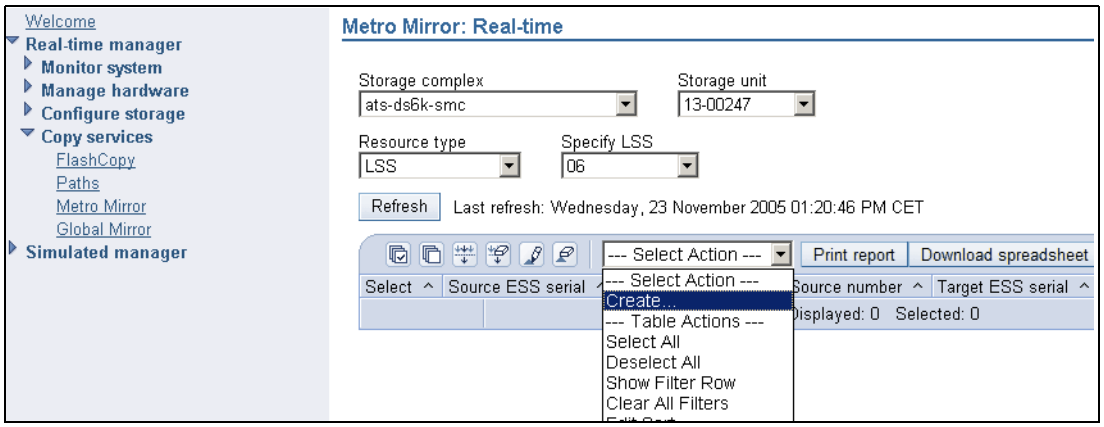

Figure 14-8 Initial Metro Mirror panel, Create pull-down selected

The panel shown in Figure 14-9 opens. Select either automated or manual volume pairing, and click **Next**.

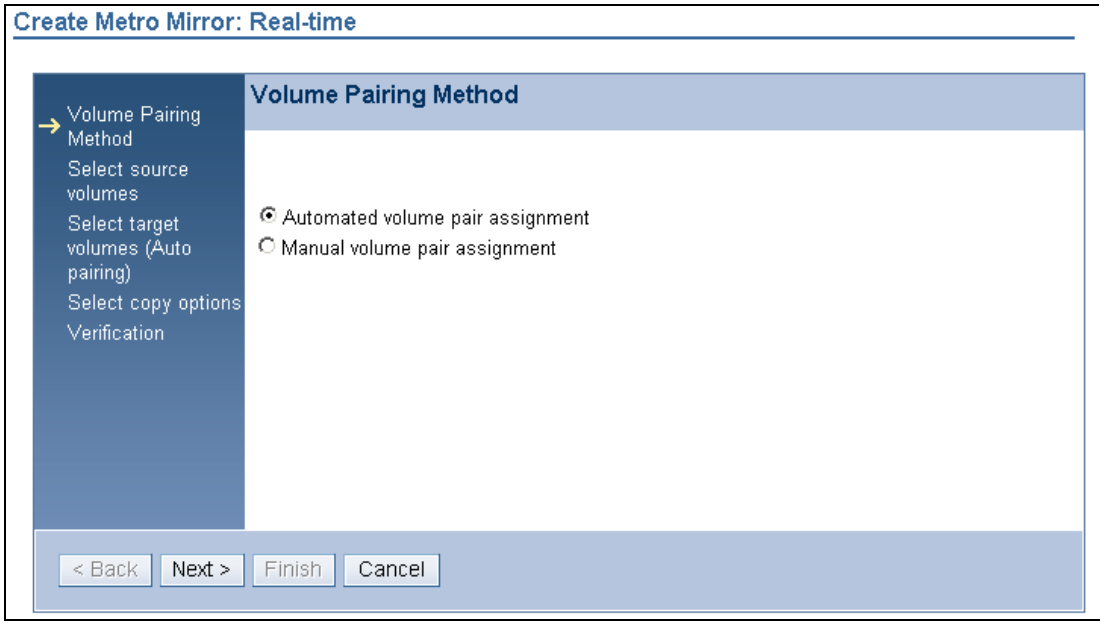

Figure 14-9 Select volume pairing method

If you select Automatic volume pair assignment, then the panel in Figure 14-10 on page 177 opens. You then page through the list of volumes listed, and check the one you want to establish.

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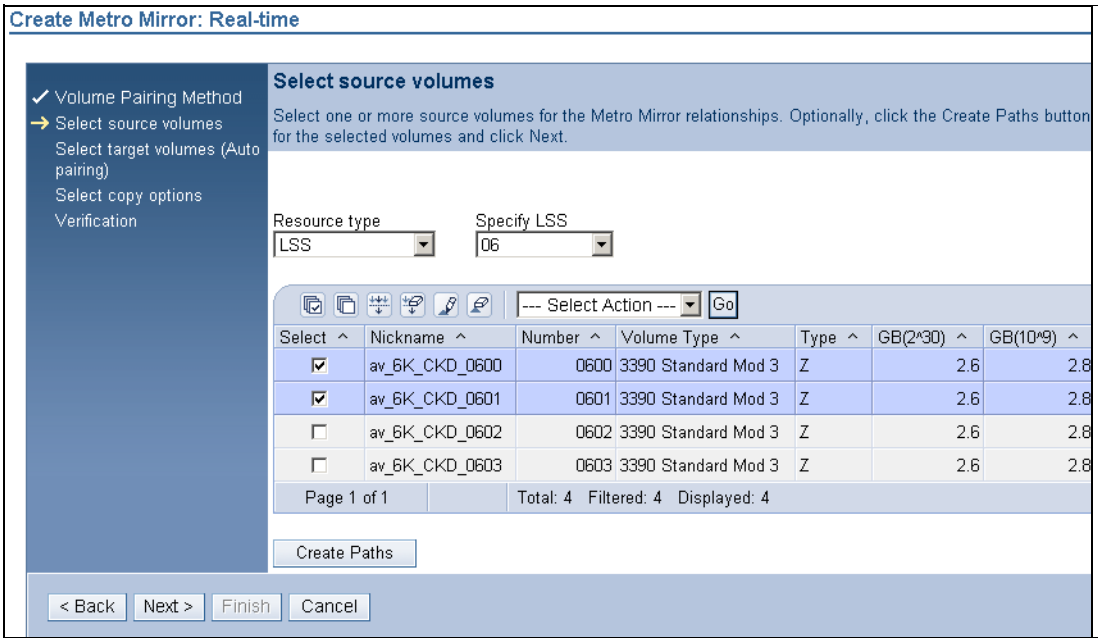

Figure 14-10 Automatic volume assignment source volume selection panel

In our example, we selected volumes **0600** and **0601**. After clicking **Next**, the panel shown in Figure 14-11 opens. On this panel you select a target volume. Because we selected automatic volume pairing, we are taken straight to the target LSS so that we can select the target volumes.

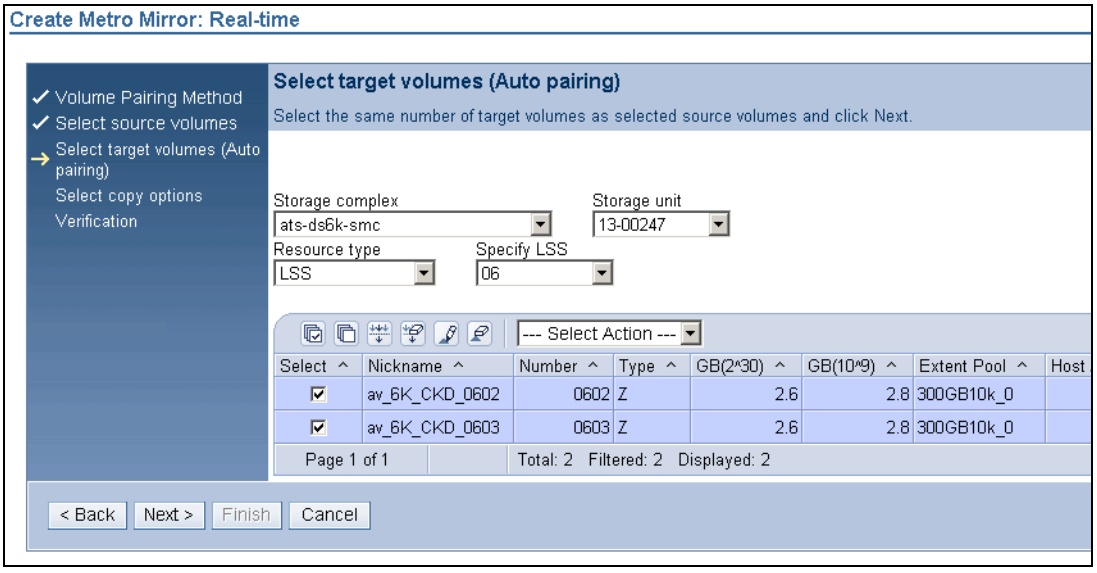

Figure 14-11 Select target volume auto pairing

In our example, we selected volumes **0100** and **0101** and clicked **Next**.

When you do this, the Copy Options panel opens, and here you can select the options you want for the Metro Mirror pair. As shown in Figure 14-12 on page 178, in our example we selected **Metro Mirror** and **Perform initial copy**. Then, click **Next**.

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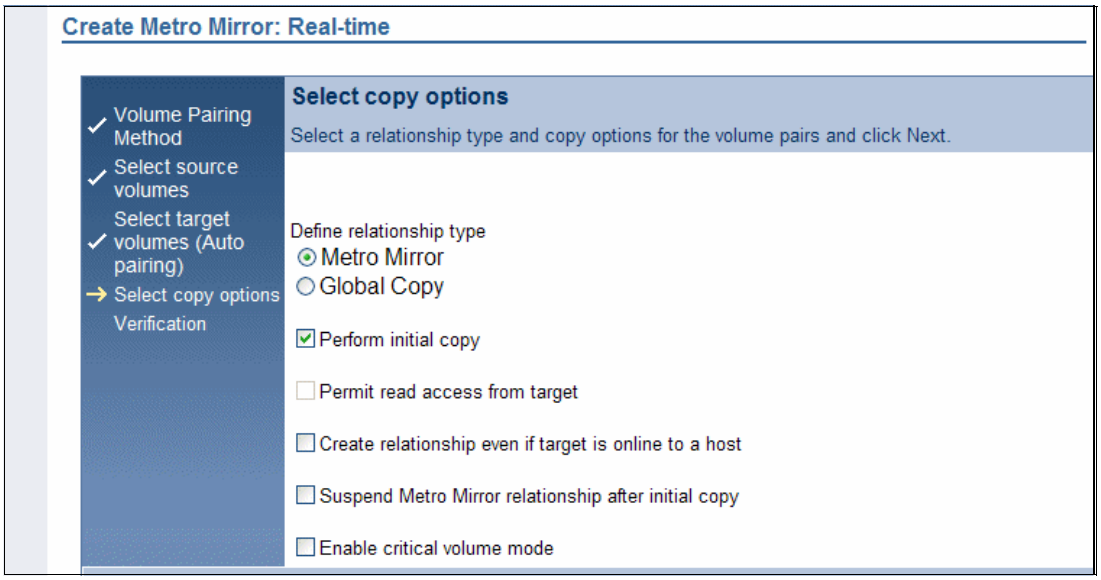
Create Metro Mirror: Real-time
Volume Pairing Method
Select source volumes
Select target volumes (Auto pairing)
Select copy options
Verification
Select copy options
Select a relationship type and copy options for the volume pairs and click Next.
Define relationship type
Metro Mirror
Global Copy
Perform initial copy
Permit read access from target
Create relationship even if target is online to a host
Suspend Metro Mirror relationship after initial copy
Enable critical volume mode

Figure 14-12 Metro Mirror options

After making these selections, the Verification panel (see Figure 14-13) opens so that you can check your selections. If all is correct, you can click **Finish**.

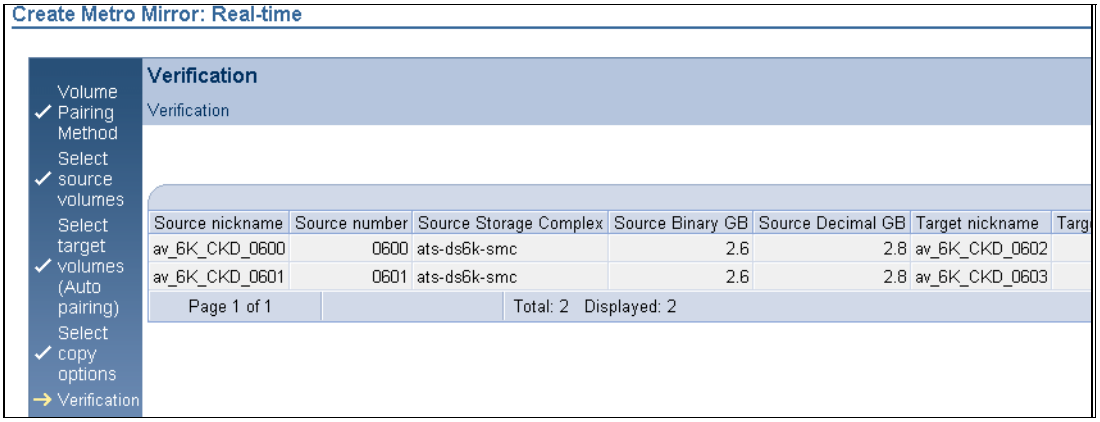

Figure 14-13 Metro Mirror pair verification panel

The Metro Mirror panel indicating the successful establishment of the Metro Mirror pairs opens, as shown in Figure 14-14.

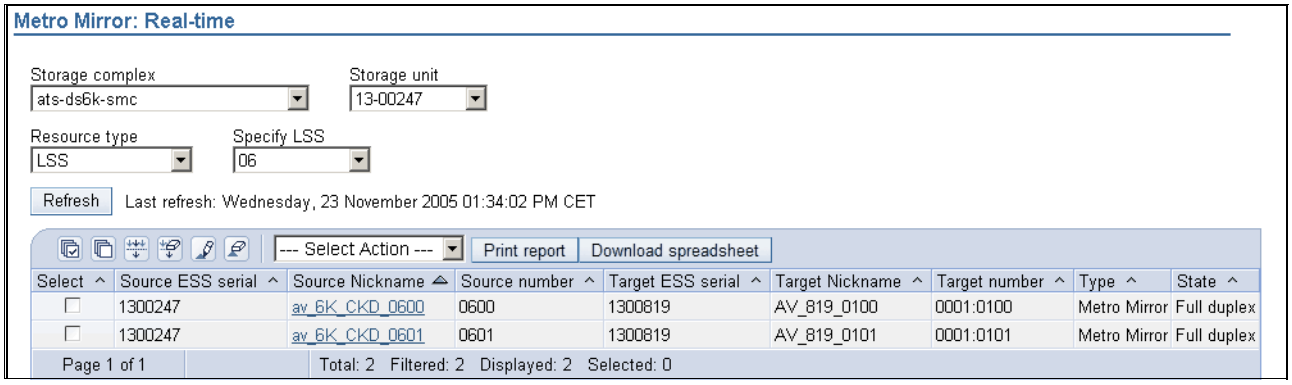

Figure 14-14 Metro Mirror pair established, full duplex state

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14.6.3 Resume suspended pair

To resume a suspended pair from the DS Storage Manager, you can follow a procedure similar to the procedure described in this section. First, you must access the Metro Mirror panel. Then, select the volume you want to resume, then click **Resume** from the Select Action menu, as shown in Figure 14-15.

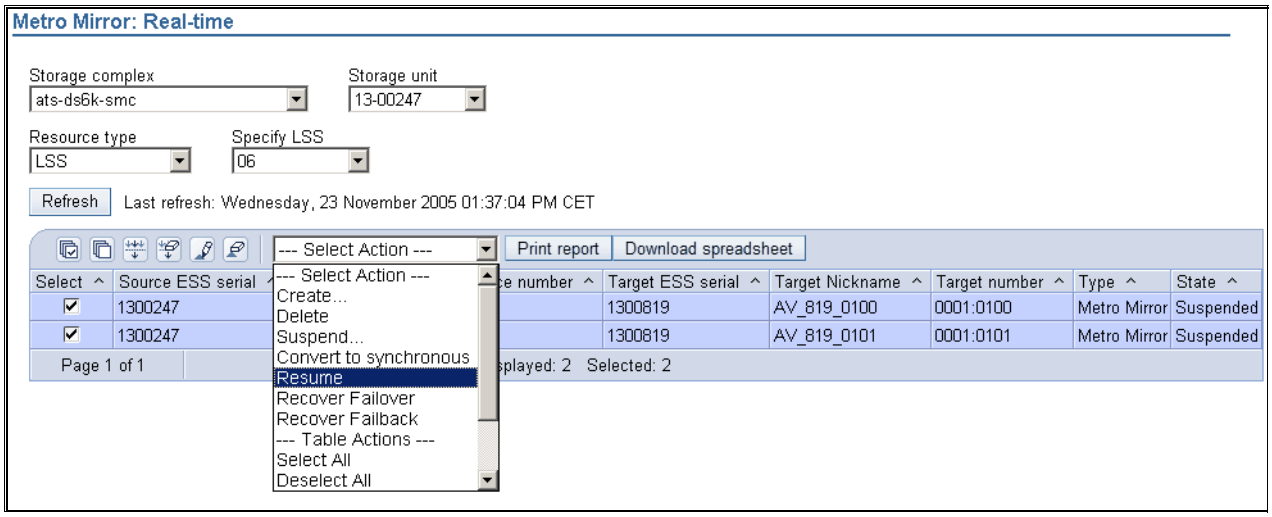

Figure 14-15 Metro Mirror resume select volume and action

The panel shown in Figure 14-16 opens. This is where you confirm that you want to resume the volume in question.

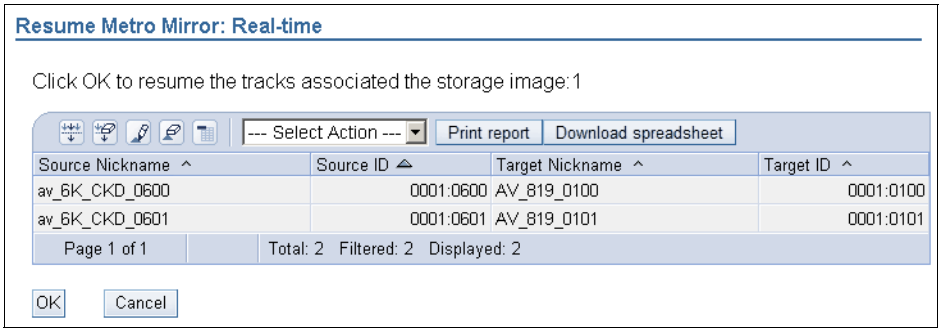

Figure 14-16 Confirm volume resume

You then return to the Metro Mirror primary panel.

14.7 ANTRQST API

The ANTRQST macro provides an application program call to the API of the z/OS system data mover. This macro allows you to call Metro Mirror, z/OS Global Mirror, and FlashCopy functions.

For detailed information, refer to *z/OS DFSMS Advanced Copy Services*, SC35-0428.

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15

Metro Mirror performance and scalability

In this chapter, we discuss performance and scalability considerations when using Metro Mirror for DS6000.

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15.1 Performance

Because Metro Mirror is a synchronous mirroring technology, it introduces a performance overhead (for write operations) as compared to a similar environment with no remote mirroring. As part of the planning process for Metro Mirror, you should understand this.

Bandwidth analysis and capacity planning for your Metro Mirror links can help define how many links you need, and when you need to add more, to ensure best possible performance.

As part of your implementation project you might be able to identify and then distribute hot spots across your configuration or take other actions to manage performance.

Note that no processor resources (CPU and memory) are consumed by your Metro Mirror volume pairs (your management solution excluded) because these resources are managed by your DS6000 subsystem.

15.1.1 Peak bandwidth requirements

When you are researching your Metro Mirror link bandwidth requirements, you must find the *peak sustained write rate*. Only writes are mirrored to the secondary volumes. For a typical z/OS system, this peak is usually during batch processing, when many updates are occurring. It could be higher still during month-end or year-end processing.

You must make allowances for this peak period when you are calculating bandwidth.

15.1.2 RMF

Resource Management Facility (RMF) can collect and report Metro Mirror link performance statistics on DS6000 subsystems, and it is used for capacity planning and trending reports. You can track the utilization of the Metro Mirror links over time and introduce new links in a planned manner.

You can also produce reports about Extent Pool and Rank performance statistics using the RMF Post Processor, if you have enabled the collection of this data through the RMF Parmlib member.

15.1.3 Initial synchronization

When doing the initial synchronization of your Metro Mirror pairs, the DS6000 uses a throttling algorithm to prevent the Metro Mirror process from using too many primary site resources. This might prolong the synchronization process if your DS6000 is busy at the time. You can choose to stagger your synchronization tasks or to run them at a time of low utilization to make this process more efficient.

As an alternative, you may also choose to do the initial synchronization in the Global Copy mode, and then switch to the Metro Mirror mode. This will allow you to bring all volumes to *duplex-pending* XD state, which has little or no application impact, and then switch to full duplex state. You can do so through TSO commands, the DS CLI, or one of the other interfaces.

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15.2 Scalability

The DS6000 Metro Mirror environment can be scaled up or down as required. If new volumes are added to the DS6000 that require mirroring, they can be dynamically added. If additional Metro Mirror paths are required, they also can be dynamically added.

Remember that in the DS6000, you have only eight Fibre Channel ports available, four per controller. Therefore, we recommend that you use two Fibre Channel links exclusively for Metro Mirror, one on each controller, for availability.

If you need more bandwidth, you can increase the number of Metro Mirror links. It should be symmetrical and it also depends on the controller used by the Extent Pool of your Metro Mirror volumes.

We think that having no more than four exclusive Metro Mirror connections make sense. It is the same as for your maximum host attachments at this time (unless you are using the DS6000 mainly as a Metro Mirror target, with few or no host activities).

As previously mentioned, the logical nature of the LSS has made a Metro Mirror implementation on the DS6000 easier to plan, implement and manage. However, if you need to add more LSSs to your Metro Mirror environment, your management and automation solutions should be set up to handle this.

The GDPS and eRCMF service offerings are designed to provide this functionality. Visit the IBM Web site and see the Services & Industry Solutions page for more information. Also see Part 8, “Solutions” on page 431.

Adding capacity to same DS6000

If you are adding capacity to an existing DS6000, providing your Metro Mirror link bandwidth is not close to or over its limit, it is possible that you only have to add volume pairs to your configuration. If you are adding more LSSs, then you must define Metro Mirror paths before adding volume pairs.

Adding capacity in new DS6000s

If you are adding new DS6000s to your configuration, you must add physical Metro Mirror links before defining your Metro Mirror paths and volume pairs. A minimum of two Metro Mirror paths per DS6000 pair is recommended for redundancy reasons. Your bandwidth analysis will indicate if you require more than two paths.

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16

Metro Mirror examples

In this chapter we show examples using TSO, ICKDSF and DS CLI commands to manage Metro Mirror. The examples presented are:

- Resynchronization of a suspended volume pair with TSO commands
- Metro Mirror Failover and Failback procedure using TSO commands
- Define a Metro Mirror volume pair using TSO commands for open systems
- Define a Metro Mirror path using ICKDSF
- Use of the **`freezepprc`** and **`unfreezepprc`** DS CLI commands

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16.1 Resynchronization of suspended volume using TSO

To resynchronize a volume that is in a suspended state we need to obtain information such as serial numbers, WWNNs, CCA and LSS numbers. We can obtain this information using the CQUERY command, and then use it to reestablish the Metro Mirror pairs. Example 16-1 shows the CQUERY command and the output information it provides.

Example 16-1 CQUERY command to obtain information

```
ANTP8802I CQUERY DEVN(6400)
ANTP0090I CQUERY FORMATTED LVL 3 739
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6400  PRIMARY..  SUSPEND(3)   ACTIVE..   0002 00 00   0003 00 01 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAVCA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   1   0000 0100   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------             *
* PRIMARY....  500507630EFFFCA0           5.0.00.0000             *
* SECONDARY.1  500507630EFFFCA0                                   *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6400. COMPLETION CODE: 00
```

We see from the output that the device number 6400 is currently a primary volume and is in suspend state. The SSID, CCA, LSS, and serial number information is on the right side of the display for both the primary (0002, 00, 00, and AAVCA) and secondary devices (0003, 00, 01, and AAVCA). The path information is also shown (one path from primary Fibre Channel adapter 0000 to secondary Fibre Channel adapter 0100).

We can see that this volume is mirrored to the same DS6000 via a loopback path (the serial number for the primary and secondary DS6000 are the same).

We now have the information required for our Metro Mirror commands.

Resynchronize the pair

The CESTPAIR command can be used to establish a Metro Mirror pair from TSO. We already had a pair established in the previous scenario; however, it was suspended. Therefore, we had to resynchronize it so that the pair would be in duplex state again. Example 16-2 on page 187 demonstrates how to use the CESTPAIR command with the MODE(RESYNC) parameter to accomplish this.

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Example 16-2 Resume suspended Metro Mirror pair from TSO

```
CESTPAIR DEVN(X'6400') PRIM(X'0002' AAVCA X'00' X'00') -
   SEC(X'0003' AAVCA X'00' X'01') OPTION(SYNC) MODE(RESYNC)

ANTP8802I CESTPAIR DEVN(X'6400') PRIM(X'0002' AAVCA X'00' X'00')
   SEC(X'0003' AAVCA X'00' X'01')           OPTION(SYN
ANTP8802I (CONT) C) MODE(RESYNC)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6400. COMPLETION CODE:
00
IEA494I 6400,DS6400,PPRC PAIR PENDING,SSID=0002,CCA=00
IEA494I 6400,DS6400,PPRC PAIR FULL DUPLEX,SSID=0002,CCA=00
```

Tip: You may want to do a FlashCopy of your recovery site prior to running the resynchronization, because the resynchronization process does not apply the updated tracks in the order they were updated, and therefore you will have a data consistency exposure until the last volume pair is again in duplex state.

16.2 Failover and failback using TSO

In this example we perform a failover and a failback using TSO commands. These options can be used in both planned and unplanned scenarios. We simulate a planned outage.

In this discussion, the volumes at the primary site are referred to as the A volumes, and the volumes at the recovery site are referred to as the B volumes. FlashCopy volumes are referred to as C volumes.

16.2.1 Failover process

The high level process for the failover in a planned scenario is as follows:

1. Quiesce applications at the primary site.
2. Issue the Metro Mirror CESTPAIR command to the secondary (B) volume as the DEVN, specifying the ACTION(FAILOVER) and reversing the original PRIMARY and SECONDARY parameters. This establishes the B volumes as suspended primaries, activates change recording on the B volumes, and releases write inhibit on the B volumes.
3. If desired, FlashCopy the B volume suspended primaries to C volumes to provide safe copies for interim disaster recovery protection.
4. Restart applications at the recovery site. This includes bringing the B volumes online.

Here we show examples of the TSO commands that can be used to accomplish these actions.

CESTPAIR with FAILOVER

We use the CESTPAIR command with the ACTION(FAILOVER) to the B volume to reverse the original Metro Mirror direction and start change recording as shown in Example 16-3. Note that we have reversed the original PRIM and SEC parameters.

Example 16-3 Establish Metro Mirror pair using TSO

```
ANTP8802I CESTPAIR DEVN(X'6430') SEC(X'2060' AAGXA X'30' X'00')
   PRIM(X'0003' AAVCA X'30' X'01') ACTION(FAILOVER)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE:
00
```


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Syslog messages

Example 16-4 shows the syslog messages from a failover operation. We are doing a failover from device 6030 to device 6430. In this example, both primary and secondary devices are available to this processors LPAR; however, this might not be the case in all Metro Mirror environments. If both devices are not available from one processor LPAR, you must issue commands on the system where the device is located.

Example 16-4 Syslog for failover operation

```
ANTP8802I CQUERY DEVN(6030)
ANTP0090I CQUERY FORMATTED LVL 3 227
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                          (PRIMARY)   (SECONDARY) *
*                                         SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  DUPLEX....   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                               *
* ----- --------- ------  ------------------                       *
*   1   0000 0000   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------            -----------            *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                   *
*********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(6430)
ANTP0090I CQUERY FORMATTED LVL 3 230
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                          (PRIMARY)   (SECONDARY) *
*                                         SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6430  SECONDARY  DUPLEX....   ACTIVE..   2060 30 00   0002 30 00 *
*       ..............       ..........  0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                               *
* ----- --------- ------  ------------------                       *
*   1   0000 0100   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------            -----------            *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                   *
*********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE: 00
IEA494I 6030,DS6030,PPRC PAIR SUSPENDED,SSID=2060,CCA=30
ANTP8802I CESTPAIR DEVN(X'6430') PRIM(X'0002' AAVCA X'30' X'00')
   SEC(X'2060' AAGXA X'30' X'00')           ACTION(FAI
ANTP8802I (CONT) LOVER)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE:
00
ANTP8802I CQUERY DEVN(6030)
```


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```
ANTP0090I CQUERY FORMATTED LVL 3 239
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  SUSPEND(3)   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                               *
* ----- --------- ------  ------------------                        *
*   1   0000 0000   13    PATH ESTABLISHED...                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*  SUBSYSTEM         WWNN                  LIC LEVEL               *
* -----------  ----------------            -----------             *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000             *
* SECONDARY.1  500507630EFFFCA0                                    *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(6430)
ANTP0090I CQUERY FORMATTED LVL 3 242
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6430  PRIMARY..  SUSPEND(3)   ACTIVE..   0002 30 00   2060 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAVCA 0000000AAGXA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                               *
* ----- --------- ------  ------------------                        *
*   1   0100 0100   13    PATH ESTABLISHED...                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*  SUBSYSTEM         WWNN                  LIC LEVEL               *
* -----------  ----------------            -----------             *
* PRIMARY....  500507630EFFFCA0            5.0.00.0000             *
* SECONDARY.1  500507630EFFFCA0                                    *
* SECONDARY.2  500507630EFFFC6F                                    *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE: 00
```

Both devices are in suspend state. Note that for device 6430, the direction of the Metro Mirror pairing has been reversed. Because the volume is in suspend state, changes will be recorded by the DS6000. At this stage you could start running your application at the secondary site.

16.2.2 Failback process

The high level failback process in a planned scenario is as follows:

1. Quiesce the applications at the recovery site.
2. Use Metro Mirror establish path commands to create paths from the recovery site to the primary site (remember, paths are required for all LSS pairs).
3. Issue Metro Mirror establish pair commands to the B volume, specifying the Failback action and reversing the original PRIM and SEC parameters. This copies any changes

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recorded on the B volumes back to the A volumes. You must vary the A volumes offline, if they are online at the primary site.

4. If you established a FlashCopy relationship (to the C volumes), you can now withdraw it.
5. Check that Metro Mirror paths exist between the A and B volumes. Reestablish, if necessary.
6. Allow Metro Mirror pairs to reach full Duplex state (use the CQUERY command, or check the syslog for IEA494I messages).
7. Issue Metro Mirror establish pair commands to A volumes specifying the ACTION(FAILOVER) with the original PRIM and SEC parameters. This reestablishes the A volumes as suspended primaries and begins change recording on the A volumes. It also releases write inhibit on the A volumes. You can vary the A volumes online again at this point.
8. You can now restart your applications at the primary site.
9. Now issue the Metro Mirror Establish pair command to the A volumes, specifying the ACTION(FAILBACK) with the original PRIM and SEC parameters. This resynchronizes the A and B volumes in the recovery configuration and restores the pairs to the Duplex state.

CESTPAIR with FAILBACK action (step 3, 9)

For step 3, the command shown in Example 16-5 will reestablish the Metro Mirror pair and copy any changes to the original primary volume (remember to keep the original PRIM and SEC parameters reversed).

Example 16-5 CESTPAIR with Failback - B to A (Step 3)

```
CESTPAIR DEVN(X'6430') PRIM(X'0002' AAVCA X'30' X'00') -
         SEC(X'2060' AAGXA X'30' X'00') -
         ACTION(FAILBACK)
```

A similar command is issued in step 9; however, it has the original Metro Mirror direction as shown in Example 16-6.

Example 16-6 CESTPAIR with Failback - A to B (Step 9)

```
CESTPAIR DEVN(X'6430') SEC(X'0002' AAVCA X'30' X'00') -
         PRIM(X'2060' AAGXA X'30' X'00') -
         ACTION(FAILBACK)
```

Syslog messages for failback process

Example 16-7 shows the syslog messages issued for the complete failback process. Note that we had access to both devices from one LPAR and therefore could perform all operations from there. You might have to split operations if you do not have access to both devices.

We issued CQUERY commands between each step of the process to check the status of our volumes. You can see the status changes and the direction of mirroring change as we progressed through the process.

Example 16-7 Syslog messages for failback process

```
ANTP8802I CQUERY DEVN(6030)
ANTP0090I CQUERY FORMATTED LVL 3 257
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                          (PRIMARY)   (SECONDARY) *
*                                        SSID CCA LSS SSID CCA LSS*
```


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```
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ---------- ---------    ---------  *
* 6030  PRIMARY..  SUSPEND(3)   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   1   0000 0000   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------            -----------            *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                   *
*******************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(6430)
ANTP0090I CQUERY FORMATTED LVL 3 260
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ---------- ---------    ---------  *
* 6430  PRIMARY..  SUSPEND(3)   ACTIVE..   0002 30 00   2060 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAVCA 0000000AAGXA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   1   0100 0100   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------            -----------            *
* PRIMARY....  500507630EFFFCA0            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                   *
* SECONDARY.2  500507630EFFFC6F                                   *
*******************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE: 00
ANTP8802I CESTPAIR DEVN(X'6430') PRIM(X'0002' AAVCA X'30' X'00')
   SEC(X'2060' AAGXA X'30' X'00')           ACTION(FAI
ANTP8802I (CONT) LBACK)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE:
00
ANTP8802I CQUERY DEVN(X'6030')
ANTP0090I CQUERY FORMATTED LVL 3 266
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ---------- ---------    ---------  *
* 6030  SECONDARY  DUPLEX....   ACTIVE..   0002 30 00   2060 30 00 *
*       ..............        ..........  0000000AAVCA 0000000AAGXA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   1   0000 0000   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
```


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```
*  SUBSYSTEM         WWNN                   LIC LEVEL             *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFCA0           5.0.00.0000            *
* SECONDARY.1  500507630EFFFC6F                                  *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(X'6430')
ANTP0090I CQUERY FORMATTED LVL 3 269
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                      SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6430  PRIMARY..  DUPLEX....   ACTIVE..   0002 30 00   2060 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAVCA 0000000AAGXA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                             *
* ----- --------- ------  -------------------                     *
*   1   0100 0100   13    PATH ESTABLISHED...                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*  SUBSYSTEM         WWNN                   LIC LEVEL             *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFCA0           5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                  *
* SECONDARY.2  500507630EFFFC6F                                  *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(6030)
ANTP0090I CQUERY FORMATTED LVL 3 272
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                      SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  SECONDARY  DUPLEX....   ACTIVE..   0002 30 00   2060 30 00 *
*       ............       ..........  0000000AAVCA 0000000AAGXA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                             *
* ----- --------- ------  -------------------                     *
*   1   0000 0000   13    PATH ESTABLISHED...                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*  SUBSYSTEM         WWNN                   LIC LEVEL             *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFCA0           5.0.00.0000            *
* SECONDARY.1  500507630EFFFC6F                                  *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(6430)
ANTP0090I CQUERY FORMATTED LVL 3 275
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                      SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6430  PRIMARY..  DUPLEX....   ACTIVE..   0002 30 00   2060 30 00 *
```


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```
*       CRIT(NO).......       CGRPLB(NO). 0000000AAVCA 0000000AAGXA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                                *
* ----- --------- ------  ------------------                       *
*   1   0100 0100   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------             *
* PRIMARY....  500507630EFFFCA0           5.0.00.0000             *
* SECONDARY.1  500507630EFFFCA0                                   *
* SECONDARY.2  500507630EFFFC6F                                   *
*********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE: 00
ANTP8802I CESTPAIR DEVN(X'6030') PRIM(X'2060' AAGXA X'30' X'00')
   SEC(X'0002' AAVCA X'30' X'00')           ACTION(FAI
ANTP8802I (CONT) LOVER)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE:
00
ANTP8802I CQUERY DEVN(6030)
ANTP0090I CQUERY FORMATTED LVL 3 283
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  SUSPEND(3)   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                                *
* ----- --------- ------  ------------------                       *
*   1   0000 0000   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------             *
* PRIMARY....  500507630EFFFC6F           5.0.00.0000             *
* SECONDARY.1  500507630EFFFCA0                                   *
*********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(6430)
ANTP0090I CQUERY FORMATTED LVL 3 286
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6430  PRIMARY..  SUSPEND(3)   ACTIVE..   0002 30 00   2060 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAVCA 0000000AAGXA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                                *
* ----- --------- ------  ------------------                       *
*   1   0100 0100   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------             *
* PRIMARY....  500507630EFFFCA0           5.0.00.0000             *
```


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```
* SECONDARY.1  500507630EFFFCA0                                  *
* SECONDARY.2  500507630EFFFC6F                                  *
*****************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE: 00
ANTP8802I CESTPAIR DEVN(X'6030') PRIM(X'2060' AAGXA X'30' X'00')
   SEC(X'0002' AAVCA X'30' X'00')           ACTION(FAI
ANTP8802I (CONT) LBACK)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE:
00
ANTP8802I CQUERY DEVN(6030)
ANTP0090I CQUERY FORMATTED LVL 3 292
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  PENDING...   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                             *
* ----- --------- ------  ------------------                      *
*   1   0000 0000   13    PATH ESTABLISHED...                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*  SUBSYSTEM         WWNN                  LIC LEVEL             *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                   *
*****************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
ANTP8802I CQUERY DEVN(6430)
ANTP0090I CQUERY FORMATTED LVL 3 295
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6430  SECONDARY  PENDING...   ACTIVE..   2060 30 00   0002 30 00 *
*       ..............       ..........  0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                             *
* ----- --------- ------  ------------------                      *
*   1   0000 0100   13    PATH ESTABLISHED...                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*  SUBSYSTEM         WWNN                  LIC LEVEL             *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                   *
*****************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6430. COMPLETION CODE: 00
```

16.3 Open systems volumes with TSO commands

It is possible to manage Metro Mirror, Global Copy, and FlashCopy of open systems devices through the TSO interface. We show an example of this.

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Establish a volume pair

Similar to System z volumes, we first have to collect the required information. In this example, we already had a path defined to the secondary subsystem. We issued a CQUERY command with the ODEVN parameter to check the status of the volume, as seen in Example 16-8. Note that we have to direct the command (using the DEVN parameter) to a z/OS device with the same server affinity as the open systems volume (therefore, in this example, we direct it to a volume in LSS 00, which has the same server affinity as LSS 16).

Example 16-8 CQUERY for open systems device

```
CQUERY DEVN(6030) ODEVN(AAGXA X'00' X'16') VOLUME
```

The serial number of the DS subsystem is supplied, along with the LUN number (x'00') and the LSS number (x'16'). The output appears similar to that shown in Example 16-9.

Example 16-9 CQUERY for open systems device output

```
ANTP8802I CQUERY DEVN(6030) ODEVN(AAGXA X'00' X'16') VOLUME
ANTP0090I CQUERY FORMATTED LVL 3 472
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID LUN LSS SSID LUN LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  .........  SIMPLEX...   INACTIVE   FF16 00 16   .......... *
*       ...............       ........... 0000000AAGXA ............*
* PATHS SAID DEST STATUS: DESCRIPTION                               *
* ----- --------- ------  -------------------                       *
*   0   ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*  SUBSYSTEM         WWNN                   LIC LEVEL              *
* -----------  -----------------            -----------            *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                     *
* SECONDARY.2  500507630EFFFCA0                                     *
*********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
```

The device is in simplex state. Note the SSID reports with special value FF16; this is the open systems LSS number preceded with FF.

We want to establish a pair with the secondary device on LSS 16, LUN number 00. The command format that we use is shown in Example 16-10.

Example 16-10 CESTPAIR command for open systems LUN

```
CESTPAIR DEVN(X'6030') PRIM(X'FF16' AAGXA X'00' X'16') -
         SEC(X'FF16' AAVCA X'00' X'16') OPENDVCS(YES) -
         OPTION(SYNC) MODE(COPY)
```

We used the OPENDVCS parameter and the special SSID value FF16 to identify that this is an open systems device, on LSS 16, and that we want to direct the command to the open systems LSS. The LUN number is supplied where we would normally supply the CCA, and the LSS number is supplied in the normal position. The output from this command and a subsequent CQUERY are shown in Example 16-11 on page 196.

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Example 16-11 CESTPAIR and CQUERY output

```
ANTP8802I CESTPAIR DEVN(X'6030') PRIM(X'FF16' AAGXA X'00' X'16')
   SEC(X'FF16' AAVCA X'00' X'16') OPENDVCS(YES)
ANTP8802I (CONT)     OPTION(SYNC) MODE(COPY)
ANTP0001I CESTPAIR COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE:
00
ANTP8802I CQUERY DEVN(6030) ODEVN(AAGXA X'00' X'16') VOLUME
ANTP0090I CQUERY FORMATTED LVL 3 478
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID LUN LSS SSID LUN LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  PENDING...   ACTIVE..   FF16 00 16   FF16 00 16 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   2   0000 0000   13    PATH ESTABLISHED...                      *
*       0100 0100   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
* IF STATE = PENDING/SUSPEND:    TRACKS OUT OF SYNC =   40523      *
*                                TRACKS ON VOLUME   =   81920      *
*                               PERCENT OF COPY COMPLETE =  51%    *
*  SUBSYSTEM         WWNN                  LIC LEVEL               *
* -----------  ----------------           -----------             *
* PRIMARY....  500507630EFFFC6F           5.0.00.0000             *
* SECONDARY.1  500507630EFFFCA0                                   *
* SECONDARY.2  500507630EFFFCA0                                   *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
```

We can see the Metro Mirror pair has established and the volume is in pending state, with 51% of tracks copied so far.

16.4 Define Metro Mirror path using ICKDSF

In this section we give an example of establishing of a Metro Mirror path using ICKDSF.

Example 16-12 ICKDSF PPRCOPY ESTPATH example

```
//EPATH   EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=RS4000,DISP=SHR
//SYSIN     DD *

 /* ------------------------------------------------------  */ -
 /* ESTABLISH PPRC PATH FROM 00/ABTV1 TO 90/BYGT1           */ -
 /* ------------------------------------------------------  */ -
    PPRCOPY DDNAME   (DD01) ESTPATH                           -
            PRI      (X'4000' ABTV1)                          -
            SEC      (X'9000' BYGT1)                          -
            LSS      (X'00' X'90')                            -
            FCPPATHS (X'00420242')                            -
            WWNN     (5005076303FFC663  5005076304FFC671)
/*
```


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Example 16-12 on page 196 shows an ICKDSF job that is defining the Metro Mirror path. Notice that the PPRCOPY ESTPATH command replaces any path definitions that currently exist.

In Example 16-13 we show the output from the ESTPATH command.

Example 16-13 PPRCOPY ESTPATH output

```
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 13:35:01

 /* ------------------------------------------------------  */ -
 /* ESTABLISH PPRC PATH FROM 00/ABTV1 TO 90/BYGT1           */ -
 /* ------------------------------------------------------  */ -
    PPRCOPY DDNAME   (DD01) ESTPATH                            -
            PRI      (X'4000' ABTV1)                           -
            SEC      (X'9000' BYGT1)                           -
            LSS      (X'00' X'90')                             -
            FCPPATHS (X'00420242')                             -
            WWNN     (5005076303FFC663  5005076304FFC671)
ICK00700I DEVICE INFORMATION FOR 4000 IS CURRENTLY AS FOLLOWS:
          PHYSICAL DEVICE = 3390
          STORAGE CONTROLLER = 1750
          STORAGE CONTROL DESCRIPTOR = E8
          DEVICE DESCRIPTOR = 0A
          ADDITIONAL DEVICE INFORMATION = 4A00003C
ICK04000I DEVICE IS IN SIMPLEX STATE
ICK02201I PPRCOPY ESTPATH FUNCTION COMPLETED SUCCESSFULLY
ICK00001I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
```

Example 16-14 shows the output from the PPRCOPY QUERY PATHS command. You can see that the path is in state 13. This indicates an established path.

Example 16-14 PPRCOPY ESTPATH output

```
ICKDSF - MVS/ESA    DEVICE SUPPORT FACILITIES 17.0               TIME: 13:35:01

 PPRCOPY DDNAME(DD01)  QUERY  PATHS
ICK00700I DEVICE INFORMATION FOR 4000 IS CURRENTLY AS FOLLOWS:
          PHYSICAL DEVICE = 3390
          STORAGE CONTROLLER = 1750
          STORAGE CONTROL DESCRIPTOR = E8
          DEVICE DESCRIPTOR = 0A
          ADDITIONAL DEVICE INFORMATION = 4A00003C
ICK04000I DEVICE IS IN SIMPLEX STATE

                        QUERY REMOTE COPY - PATHS

       PRIMARY CONTROL UNIT INFORMATION
             SERIAL         LSS  WORLD WIDE
             NUMBER   SSID  NUM  NODE NAME
             -------  ----  ---  ----------------
             ABTV1    4000  00   5005076303FFC663

       SECONDARY CONTROL UNIT INFORMATION
             SERIAL         WORLD WIDE
             NUMBER   SSID  NODE NAME         PATH  SAID  DEST  S*
             -------  ----  ----------------  ----  ----  ----  --
       1ST:  BYGT1    9000  5005076304FFC671  1     0042  0242  13
       2ND:  .......  ....  ................  .     ....  ....  00
       3RD:  .......  ....  ................  .     ....  ....  00
```


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```
       4TH:  .......  ....  ................  .     ....  ....  00

       S*=PATH STATUS
         00=NO PATH
         ......
         13=ESTABLISHED FIBRE CHANNEL PATH
         ......

ICKO2206I PPRCOPY QUERY FUNCTION COMPLETED SUCCESSFULLY
ICKOOOOlI FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
```

16.5 DS CLI freezepprc and unfreezepprc commands

When you want to suspend all Metro Mirror pairs (and remove paths) between a pair of LSSs, you use the **freezepprc** command (or its equivalent in the other interfaces). It is used for data consistency purposes to give a recovery point at your secondary site.

When the path is defined as a Consistency Group path, issuing a **freezepprc** command causes an extended long busy condition for all Metro Mirror pairs on the LSS pairing. Once you have issued **freezepprc** commands for all LSS pairs, you can then issue an **unfreezepprc** command (or equivalent in the other interfaces) to remove the extended long busy.

Example 16-15 shows an example of the use of the DS CLI **freezepprc** and the **unfreezepprc** commands.

Example 16-15 freezepprc DS CLI command

```
dscli> freezepprc -dev ibm.1750-13aavca -remotedev ibm.1750-13aavca 00:01
Date/Time: 8 June 2005 04:44:54 PM IBM DSCLI Version: 5.0.3.5 DS: IBM.1750-13AAVCA
CMUC00161W freezepprc: Remote Mirror and Copy consistency group 00:01 successfully created.
dscli>
dscli> unfreezepprc -dev ibm.1750-13aavca -remotedev ibm.1750-13aavca 00:01
Date/Time: 4 June 2005 01:27:38 PM IBM DSCLI Version: 5.0.3.134 DS: IBM.1750-13AAVCA
CMUC00198I unfreezepprc: Remote Mirror and Copy pair 00:01 successfully thawed.
dscli>
```

These commands can be issued by your automation routine to create data consistency at the first error message (to prevent a *rolling disaster* situation). The **freezepprc** command is issued to all LSS pairs as quickly as possible, followed by **unfreezepprc** commands.

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Part 5

Global Copy

In this part of the book, we describe IBM System Storage Global Copy for DS6000. After presenting an overview of Global Copy, we discuss the options available, the interfaces you can use, and the configuration considerations. We also provide examples of the use of Global Copy.

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Global Copy overview

In this chapter we describe the characteristics and operation of Global Copy. Also discussed are the considerations for its implementation with the IBM System Storage DS6000.

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17.1 Global Copy overview

Global Copy (formerly known as PPRC Extended Distance, or PPRC-XD) is a non-synchronous remote copy function for System z and open systems for longer distances than are possible with Metro Mirror. It is appropriate for remote data migration, offsite backups, and transmission of inactive database logs at virtually unlimited distances.

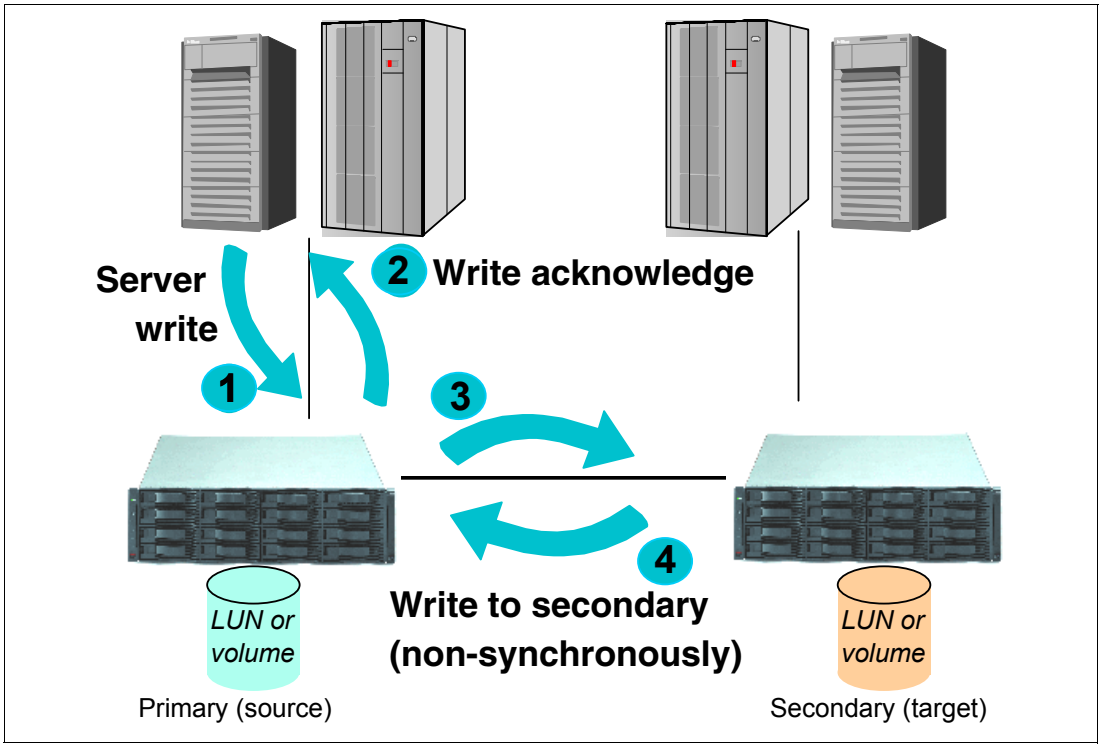

Figure 17-1 Global Copy

With Global Copy, write operations complete on the primary disk subsystem before they are received by the secondary disk subsystem. This capability is designed to prevent the primary system's performance from being affected by wait time from writes on the secondary system. Therefore, the primary and secondary copies can be separated by any distance. Figure 17-1 illustrates how Global Copy operates, and the flow is described here:

1. The host server makes a write I/O to the primary DS6000. The write is staged through cache and non-volatile storage (NVS).
2. The write returns as completed to the host server's application.
3. At a later time (that is, in a non-synchronous manner), the primary DS6000 sends the necessary data so that the updates are reflected on the secondary volumes. The updates are grouped in batches for efficient transmission.
4. The secondary DS6000 returns write complete to the primary DS6000 when the updates are secured in the secondary DS6000 cache and NVS. The primary DS6000 then resets its Global Copy change recording information.

Note: The efficient extended distance mirroring technique of Global Copy is achieved with sophisticated algorithms. For example, if changed data is in the cache, then Global Copy sends only the changed sectors. There are also sophisticated queuing algorithms to schedule the processing of updating the tracks for each volume and set the batches of updates to be transmitted.

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17.2 Volume states and change logic

Figure 17-2 illustrates the basic states and the change logic of a volume that is in either a Metro Mirror or Global Copy relationship. The following considerations apply to the volume states when the pair is a Global Copy pair:

- **Simplex**: The volume is not in a Global Copy relationship.
- **Suspended**: In this state, the writes to the primary volume are not mirrored onto the secondary volume. The secondary volume becomes out-of-sync. During this time, Global Copy keeps a bitmap record of the changed tracks in the primary volume. Later, the volume pair can be restarted, and then only the tracks that were updated are copied.
- **Full duplex**: A Global Copy volume never reaches this volume state. In the full duplex condition, updates on the primary volumes are synchronously mirrored to the secondary volume—with Metro Mirror, this is possible. With Global Copy, however, even when no tracks are out of sync, the pair remains in copy pending status.
- **Copy Pending**: Updates on the primary volume are non-synchronously mirrored to the secondary volume.

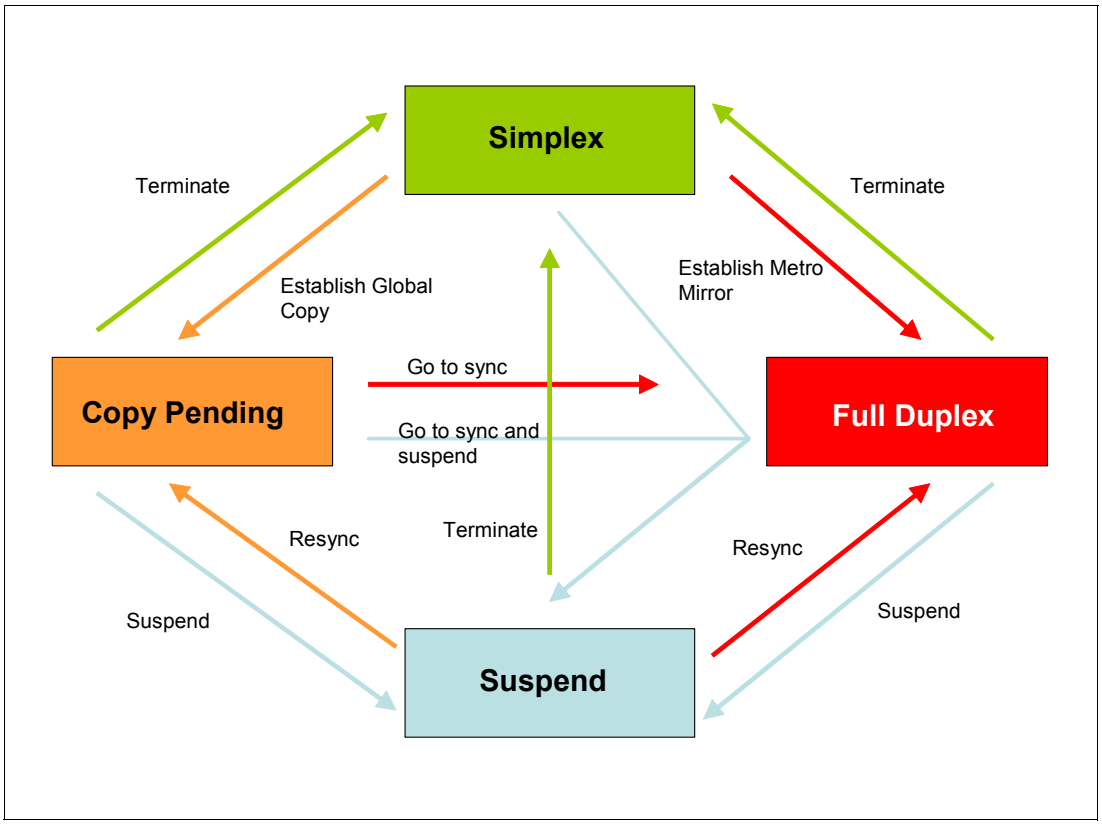

Figure 17-2 Global Copy and Mirror state change logic

In regard to the state change logic, the following considerations apply:

- When you initially establish a mirror relationship from a volume in simplex state, you have the option to request that it becomes a Global Copy pair (see the Establish Global Copy arrow in Figure 17-2), or a Metro Mirror pair (see the Establish Metro Mirror arrow in Figure 17-2).
- Pairs can change from the copy pending state to the full duplex state when a go-to-SYNC operation is executed (see the Go to sync arrow in Figure 17-2).

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- You can also request that a pair be suspended as soon as it reaches the full-duplex state (see go to sync and suspend in Figure 17-2).
- Pairs cannot change directly from full duplex state to copy pending state. They must go through an intermediate suspend state.
- You can go from suspended state to copy pending state during an incremental copy (copying out-of-sync tracks only). This process is similar to the traditional transition from suspended state to full duplex state (see the Resync arrow in Figure 17-2 on page 203).

17.3 Global Copy positioning

Figure 17-3 lists the main points for considering Global Copy.

Global Copy is a recommended solution for remote data copy, data migration and offsite backup - over continental distances without impacting application performance.

It can be used for application recovery implementations if application I/O activity can be quiesced and non-zero data loss RPO is admissible.

- It can be used over continental distances with excellent application performance
  - The distances only limited by the network and channel extenders capabilities
- Application write operations do not have synchronous-like overheads
- Fuzzy copy of data at the recovery site (sequence of dependent writes may not be respected at the recovery site)
- Recovery data can become a consistent point-in-time copy of the primary data, if appropiate application checkpoints are set to do global catch-ups
  - Pairs are synchronized with application group consistency
- Synchronizations can be done more frequently, because of short catch-ups
  - RPO still not zero, but improves substantially

Figure 17-3 Global Copy positioning

As summarized in Figure 17-3, Global Copy is a recommended solution when you want to perform remote data copy, data migration, offsite backup, and transmission of inactive database logs without impacting application performance, which is particularly relevant when implemented over continental distances. Global Copy can also be used for application recovery solutions based on periodic point-in-time copies of the data. This requires short quiescings of the application's I/O activity.

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Global Copy options and configuration

This chapter discusses the options available when using Global Copy. It also discusses the configuration guidelines that should be considered when planning for Global Copy with the IBM System Storage DS6000.

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18.1 Global Copy basic options

First we review the basic options available when working with Global Copy. You will see that many of these options are common to Metro Mirror. However, keep in mind that the results may differ because Metro Mirror and Global Copy have differences in the way they work.

18.1.1 Establish Global Copy pair

This is the operation where you establish a Global Copy relationship between a primary (source) and a secondary (target) volume—that is, you establish a Global Copy pair. During this operation, the volumes will transition from the simplex state to the copy pending state.

When you establish a Global Copy pair, the following options are available:

- No copy

  This option does not copy data from the primary to the secondary volume. This option assumes that the volumes are already synchronized. The data synchronization is your responsibility and the DS6000 does not check its synchronization.

- Target read

  This option allows host servers to read from the secondary volume. In order for a host server to read the volume, the volume pair must be in full duplex state. Note that this parameter applies to open systems volumes; it does not apply to System z volumes.

- Suspend after data synchronization

  This option suspends the remote copy pairs after the data has been synchronized. You can use this option with the Go-to-sync operation (the Go-to-sync operation is discussed in 18.1.5, “Convert a Global Copy pair to Metro Mirror” on page 207).

- Wait option

  This option delays the command response until the volumes are in one of the final states: simplex, full duplex, suspended, target full duplex, or target suspended. This parameter cannot be used with **`-type gcp`** or **`-mode nocp`**, but it can be used with the Go-to-sync operation.

- Reset reserve on target

  This option allows the establishment of a Global Copy relationship when the secondary volume is reserved by another host. If this option is not specified and the secondary volume is reserved, the command fails. This parameter can only be used with open system volumes.

18.1.2 Suspend Global Copy pair

This operation stops copying data to the secondary volume and leaves the pair in suspended state. Because the primary DS6000 keeps a record of all changed tracks on the primary volume, you can resume the remote copy operation at a later time.

18.1.3 Resume Global Copy pair

This operation resumes a Global Copy relationship for a volume pair and starts to copy data back again to the secondary volume. Only modified tracks are sent to the secondary volume, because the DS6000 kept a record of all changed tracks on the primary volume while the volumes were suspended. When resuming a Global Copy relationship, you can use the same options you use to initially establish a Global Copy pair, except for the *no copy* option.

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18.1.4 Terminate Global Copy pair

This operation ends the remote copy relationship between the volume pair; the volumes return to the simplex state.

18.1.5 Convert a Global Copy pair to Metro Mirror

This operation is known as the *Go-to-sync* operation. There are two common situations when you would convert a pair from Global Copy mode to Metro Mirror mode:

- Situation 1

  You have used Global Copy to complete the bulk transfer of data in the creation of many copy pairs, and you now want to convert some or all of those pairs to Metro Mirror mode.

- Situation 2

  You have Global Copy pairs for which you want to make FlashCopy backups on the recovery site. You convert the pairs temporarily to Metro Mirror mode in order to obtain point-in-time consistent copies.

The transition of a volume pair from Global Copy to Metro Mirror is also referred to as the *catch-up* transition, and it is discussed in the following section.

18.2 Catch-up transition

Copy Pending *catch-up* is the name of the transition for a Global Copy pair that goes from its normal out-of-sync condition to a fully synchronous condition, that is, a full duplex Metro Mirror pair. The pair goes from the *pending* state to the *duplex* state. At the end of this transition, primary and secondary volumes are fully synchronized, with all their respective tracks identical.

As a result of the catch-up, the Global Copy pair becomes a Metro Mirror pair. This has an impact on application response times because write I/Os in a Metro Mirror pair are written to both primary and secondary volumes before the host application is acknowledged. For this reason, a Global Copy pair is normally synchronized only for short periods of time, typically to make a FlashCopy, and host application updates are quiesced for the duration. Refer to 18.3, “Create a consistent point-in-time copy” on page 209 for a more detailed discussion.

18.2.1 Go-to-sync using TSO

You can initiate a catch-up operation by commanding Global Copy to go-to-SYNC with the TSO command **CESTPAIR**. For the go-to-SYNC, the **CESTPAIR** command must be used with the **OPTION(SYNC)** and **MODE(RESYNC)** parameters; see Table 18-1.

Table 18-1 CESTPAIR parameter values for the go-to-SYNC transition

Operation	Volume pair state		CESTPAIR parameter values	
	from	**to**	**OPTION**	**MODE**
go-to-SYNC catch-up	*duplex pending* XD	*duplex*	SYNC	RESYNC

Example 18-1 shows the TSO **CESTPAIR** command to change a Global Copy pair to synchronous mode.

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Example 18-1 TSO initiated go-to-sync transition

```
CESTPAIR DEVN(X'400A') OPTION(SYNC) MODE(RESYNC) -
PRIM(X'4000' ABTV1 X'0A' X'00') -
SEC(X'8000' 20781 X'8A' X'80')
```

Note: The CESTPAIR command does not support the go-to-SYNC and suspend operation (ICKDSF and the DS CLI do). When using the TSO interface, to suspend as soon as the duplex state is reached, you must automate the process by triggering on the state change messages that the system issues.

18.2.2 Go-to-sync using ICKDSF

You can initiate a catch-up operation by commanding Global Copy to go-to-SYNC using the ICKDSF PPRCOPY CESTPAIR command; see Example 18-2. The CESTPAIR command must be used with the OPTION(SYNC) and MODE(RESYNC) parameters.

Example 18-2 ICKDSF-initiated go-to-sync transition

```
PPRCOPY ESTPAIR UNIT(4C80) LSS(X'01',X'05') -
PRI(X'2901',FCA29,X'00') SEC(X'2805',FCA28,X'00') -
OPTION(SYNC)
```

18.2.3 Go-to-sync using the DS Storage Manager

In the DS Storage Manager, in the Metro Mirror panel you can display the Metro Mirror or Global Copy pairs and perform specific actions on them; see Figure 18-1.

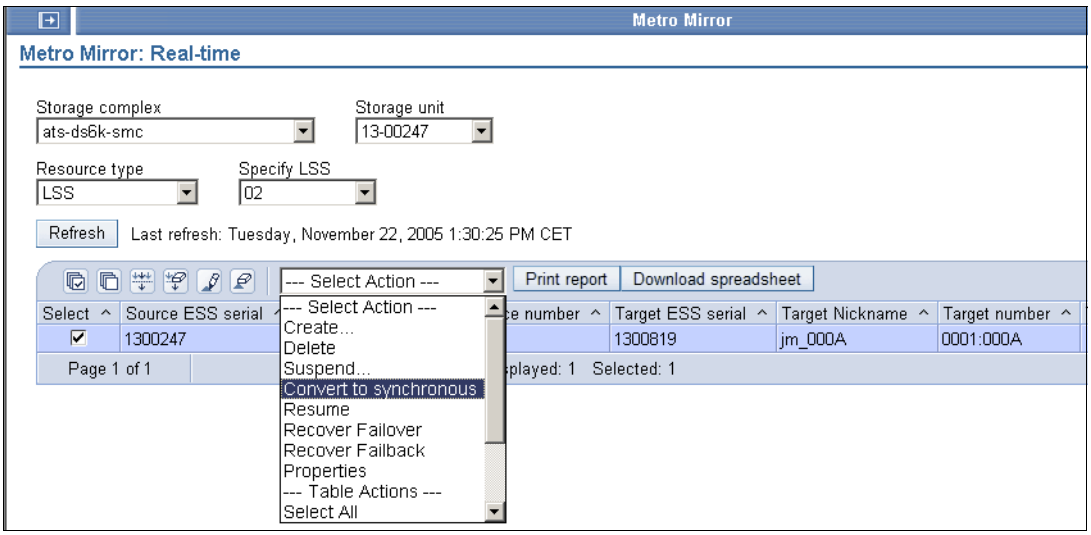

Figure 18-1 Convert to synchronous using GUI

To convert a Global Copy pair to a Metro Mirror pair, you can select the Global Copy pair and select **Convert to synchronous** from the Select Actions menu.

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18.2.4 Go-to-sync using the DS CLI

You can also use the DS CLI command **mkpprc** with the option **-mmir** to synchronize a Global Copy pair, as shown in Example 18-3.

Example 18-3 mkpprc command

```
dscli> mkpprc -dev ibm.1750-13aagxa -remotedev ibm.1750-13aavca -type mmir   000d:000d
Date/Time: 17. Juni 2005 00:01:00 CEST IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 000D:000D successfully
created.
```

18.2.5 Display out-of-sync tracks

After a Global Copy pair is established, the volumes go into the copy pending state. The copy pending state also remains if no tracks are out-of-sync. You can display the out-of-sync tracks with the DS CLI or with the DS Storage Manager.

With the DS CLI you can use the **lspprc** command; see Example 18-4.

Example 18-4 lspprc command

```
dscli> lspprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA -l 1610
Date/Time: June 14, 2005 5:51:35 PM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
ID        State        Reason Type        Out Of Sync Tracks Tgt Read Src Cascade Tgt Casc
==========================================================================================
1610:1609 Copy Pending -      Global Copy 71030              Disabled Disabled    Disabled
```

In the DS Storage Manager, you can display the out-of-sync tracks in the Metro Mirror properties window; see Figure 18-2.

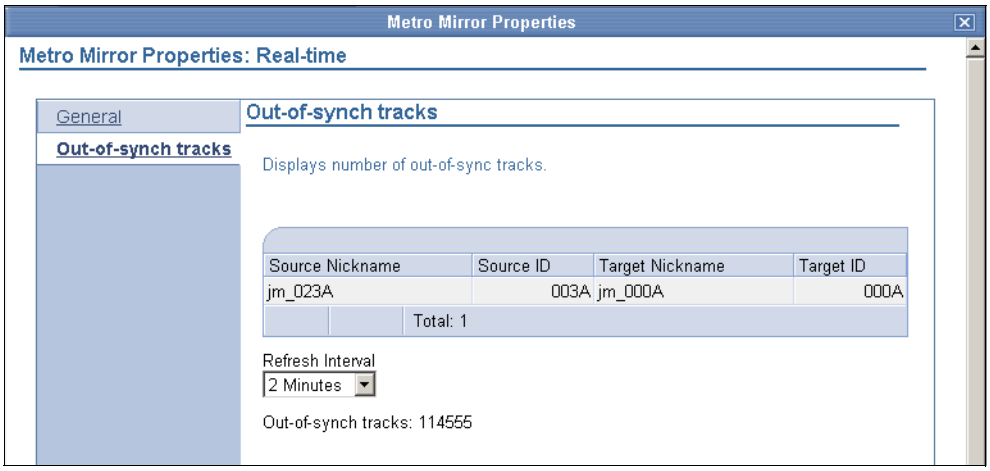

Figure 18-2 Out-of-sync tracks

18.3 Create a consistent point-in-time copy

While the copy pair volumes are in the copy pending state, the secondary volumes maintain a *fuzzy copy* of the data:

- Because of the non-synchronous data transfer characteristics, at any time there is a certain amount of updated data that is not reflected at the secondary volume. This data

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corresponds to the sectors that were updated since the last volume bitmap scan was done. These are the out-of-sync sectors.

- Because of the bitmap scan method, writes might not be applied on to the secondary volume in the same sequence as they are written to the primary volume.

When terminating the Global Copy relationship to establish host access to secondary volumes, the first issue might cause you to lose transactions. Since a file system or database consistency depends on the correct ordering of write sequences, the second issue might cause inconsistent volumes. Therefore, to use secondary volumes by the host systems, you must make them *point-in-time consistent*:

- The application must be quiesced and the volume pairs temporarily suspended. This is necessary for ensuring consistency not only at the volume level, but also at the application level.
- The secondary volumes have to *catch-up* to their primary counterparts. Global Copy catch-up is the name of the transition that occurs to a Global Copy pair when it goes from its normal out-of-sync condition until it reaches a full sync condition. At the end of this transition, the primary and secondary volumes become fully synchronized.
- A FlashCopy of the secondary volumes onto tertiary volumes should now be performed, followed by resuming the Global Copy pairs.

These tertiary volumes are then a consistent point-in-time copy of the primary volumes.

Figure 18-3 illustrates a procedure to get a consistent point-in-time copy at the secondary site.

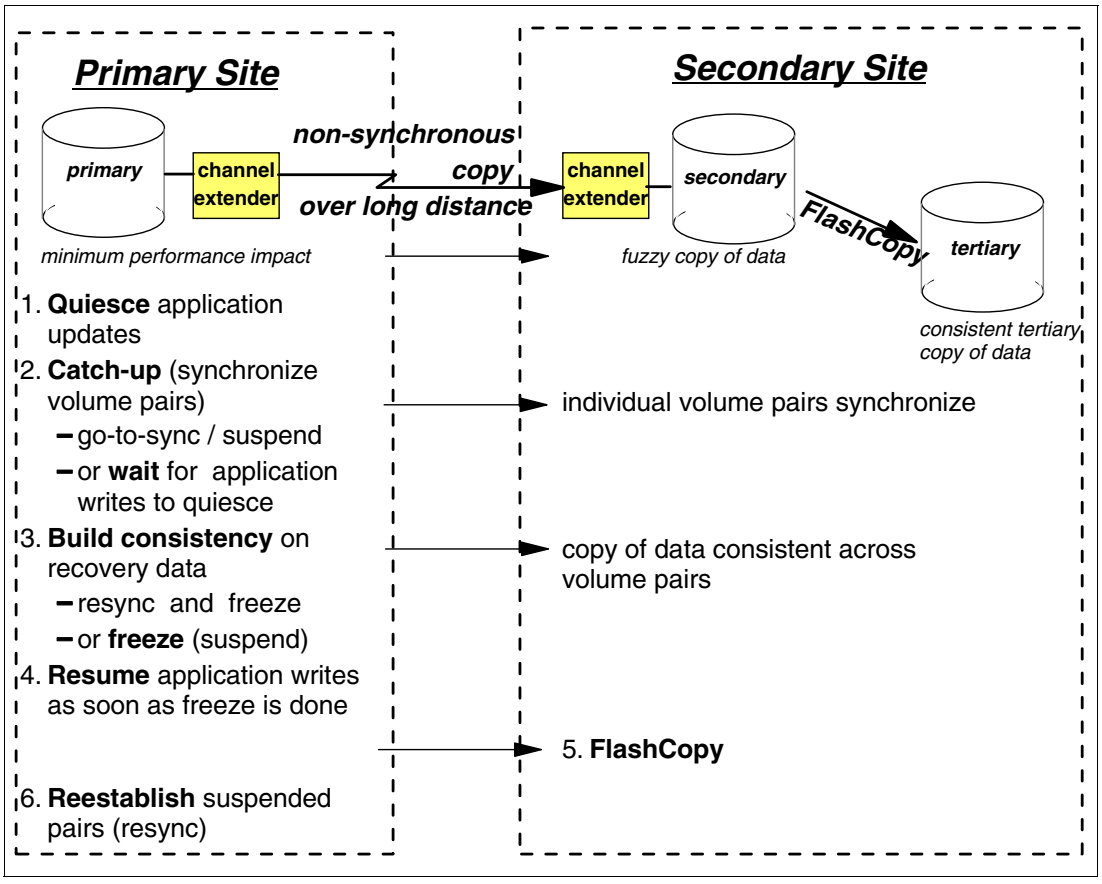

Figure 18-3 Create a Global Copy consistent copy

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The steps in the procedure shown in Figure 18-3 are the following:

1. Quiesce the application updates.
2. Synchronize the volume pairs by one of these methods:
   - Perform the catch-up by doing a *go-to-sync* operation. This can be done with the Storage Manager as shown in 18.2.3, “Go-to-sync using the DS Storage Manager” on page 208. The volume pair leaves the copy pending state and reaches the full duplex state. At this time, if the pairs were not immediately suspended, primary write updates would be synchronously transmitted to the recovery site.
   - Perform the catch-up by waiting until all application updates are transferred to the secondary site.

   You can monitor the number of out-of-sync tracks with the DS Storage Manager or with the DS CLI as shown in 18.2.5, “Display out-of-sync tracks” on page 209.
3. Suspend the Global Copy pairs after they reach the full duplex state. If you use Consistency Groups, issue do a freeze operation.

   At this point, we have a set of consistent secondary volumes.
4. You can resume the application. Updates are not copied to the secondary volumes because the pairs are suspended. The secondary volumes remain consistent, and the application does not experience any response time impact.
5. Perform a FlashCopy on the secondary volumes.
6. Resume Global Copy mode for the copy pair.

For applications recovery based on point-in-time copies, you must plan for appropriate checkpoints to briefly quiesce the application and synchronize the volumes pairs. When the recovery of the application is done, you must remember that, while in an active Global Copy relationship, the secondary volumes always have a current fuzzy copy of the primary volumes, so you have to keep the tertiary volumes where you did a FlashCopy of the last globally consistent catch-up. Therefore, this tertiary copy does not reflect the current update, but rather any updates up until the last global catch-up operation.

18.4 Cascading for ESS migration

Asynchronous cascading PPRC is a function of the IBM TotalStorage Enterprise Storage Server (ESS), where the secondary volume of a Global Copy or Metro Mirror volume pair becomes the primary volume of another Global Copy or Metro Mirror relationship. Cascading allows you to set a remote copy relationship from a source volume through an intermediate volume to a target volume.

The two volume pairs in a cascaded relationship can be either Global Copy or Metro Mirror pairs with one exception: the first pair (source to intermediate) cannot be Global Copy if the second pair (intermediate to target) is Metro Mirror. The two pairs can be established in any order; that is, first and second here do not refer to the order of establishment.

Cascading can be useful when you are migrating data from an ESS to the DS6000. If the volumes to be migrated are mirrored between two ESSs with Metro Mirror, you can set up a cascaded Global Copy from the secondary ESS to the DS6000. Then, you can migrate the volumes without having to delete the existing volume pairs.

Cascading can also be used if you need to migrate data from an ESS Model F20 to a DS6000. This cannot be done directly with Global Copy because the ESS F20 only supports ESCON remote copy links, while the DS6000 only supports FCP links. The migration can be

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done using an ESS 800 (or ESS 750) as an intermediate unit, because the ESS 800 supports, with PPRC Version 2, both ESCON and FCP links. In this setup, the source volumes on the ESS F20 would be copied to intermediate volumes on the ESS 800 using Global Copy (or Metro Mirror), and they in turn would be copied to the target volumes on the DS6000 using cascading Global Copy. The intermediate ESS has to be at LIC level 2.4.3.65 or later in order to support Global Copy with the DS6000.

A cascaded relationship is established with the second volume pair (intermediate to target). In TSO, this is done by specifying parameter CASCADE(YES) on the CESTPAIR command, as shown in Example 18-5. In the example, device 4C80 is the intermediate volume.

Example 18-5 Cascading with TSO

```
CESTPAIR DEVN(X'4C80') OPTION(XD) MODE(COPY) CASCADE(YES) -
LSS(X'01',X'05') -
PRI(X'2901' FCA29 X'00' X'01') SEC(X'2805' FCA28 X'00' X'05')
```

The respective parameter for the ICKDSF ESTPAIR command is CASCADE; see Example 18-6.

Example 18-6 Cascading with ICKDSF

```
PPRCOPY ESTPAIR UNIT(4C80) OPTION(XD) MODE(COPY) CASCADE -
LSS(X'01',X'05') -
PRI(X'2901',FCA29,X'00') SEC(X'2805',FCA28,X'00')
```

In DS CLI, a cascading relationship is established by specifying parameter **-cascade** for the **mkpprc** command, as shown in Example 18-7.

Example 18-7 Cascading with CLI

```
mkpprc -dev ibm.2105-22399 remotedev ibm.1750-1300247 -type gcp -mode full -cascade
050a:023a
Date/Time: November 25, 2005 10:28:17 AM EET IBM DSCLI Version: 5.1.0.204 DS:
IBM.2105-22399
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 050A:023A successfully
created.

lspprc -dev ibm.2105-22399 050a
Date/Time: November 25, 2005 10:28:42 AM EET IBM DSCLI Version: 5.1.0.204 DS:
IBM.2105-22399
ID        State               Reason Type        SourceLSS Timeout (secs) Critical Mode Fir
==========================================================================================
011A:050A Target Copy Pending -      Global Copy 01        unknown        Disabled
050A:023A Copy Pending        -      Global Copy 05        unknown        Disabled
```

In the example, 011A is the source volume, 050A is the intermediate volume, and 023A is the target volume. The **lspprc** command shows the status of both volume pairs where the intermediate volume 050A belongs. 011A:050A is the first pair where 050A is the secondary, and 050A:023A is the second pair where 050A is the cascading primary.

Note that ESS F20 does not support DS CLI. The Global Copy relationships between the ESS F20 and the ESS 800 can be managed using, for example, TSO. The relationships between the ESS 800 and the DS6000 can also be managed using the DS CLI.

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18.5 Hardware requirements

Global Copy is an optional licensed function of the IBM System Storage DS6000 series. The licensed function is the Remote Mirror and Copy (RMC), and is the same that is used to acquire the Metro Mirror and the Global Mirror licensed functions.

You have to purchase the corresponding licensed function for the primary and secondary DS6000 systems.

Note: For a detailed explanation of the features involved and the considerations you must keep in mind when ordering Global Copy, we recommend that you refer to the IBM System Storage DS6000 Series (IBM 1750-522) announcement letter.

IBM announcement letters can be found at http://www.ibm.com/products

For additional information on the DS6000 licensed function features, see also Appendix C, “Licensing” on page 525.

All DS6000 series licensed functions are enabled, authorized, managed, activated, and enforced based upon the physical capacity contained in a 1750 system.

Enablement refers to the purchase of a feature number to technically activate the associated licensed function. Each licensed function is *enabled* for a 1750 system through acquiring the corresponding feature numbers.

Particularly for Global Copy, the 1750 feature that must be ordered is the Remote Mirror and Copy (RMC) licensed function, feature number 53xx; see Table 18-2.

Table 18-2 DS6000 Remote Mirror and Copy feature codes

Feature Code	Description
5310	RMC - 1 TB Unit
5311	RMC - 5 TB Unit
5312	RMC - 10 TB Unit
5313	RMC - 25 TB Unit
5314	RMC - 50 TB Unit

Each licensed function feature number purchased for a 1750 machine enables that function for the entire 1750 system.

Authorization refers to the purchase of a feature number to establish the extent of IBM *authorization*—license size in terms of physical capacity—for use of an associated licensed function. This is also referred to as the *authorization level*.

The extent of IBM authorization for the use of a licensed function on a 1750 system is established by acquiring 53xx feature number on the 1750 base enclosure. The same 53xx feature numbers acquired to enable a licensed function also establish the extent of IBM's authorization.

The 53xx feature number on a 1750 base enclosure establishes the authorization level for the entire 1750 system. For example, a 1750 system with a Model 522 base enclosure and two Model EX2 expansion enclosures requires the acquisition of 53xx feature numbers only on the Model 522.

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Therefore, for licensed functions authorized on the basis of physical capacity—as in the case of RMC—the authorization level established with the acquisition of the 53xx feature number on the Model 522 must also cover the physical capacity of the attached Model EX2 expansion enclosures.

Interoperability

Global Copy pairs can only be established between disk subsystems of the same (or similar) type and features. For example, a DS6000 can have a Global Copy pair with another DS6000, a DS8000, an ESS 800, or an ESS 750. It cannot have a Global Copy pair with an RVA or an ESS F20. Note that all disk subsystems must have the appropriate licensed function feature installed. If your DS6000 is being mirrored to an ESS disk subsystem, the ESS must have PPRC Version 2 (which supports Fibre Channel links) with the appropriate licensed internal code level (LIC).

Refer to the DS6000 Interoperability Matrix for more information:

`http://www-1.ibm.com/servers/storage/disk/ds6000/interop.html`

18.6 DS6800 I/O ports

The DS6800 can have a maximum number of eight I/O ports; see Figure 18-4. Each I/O port has an I/O port number.

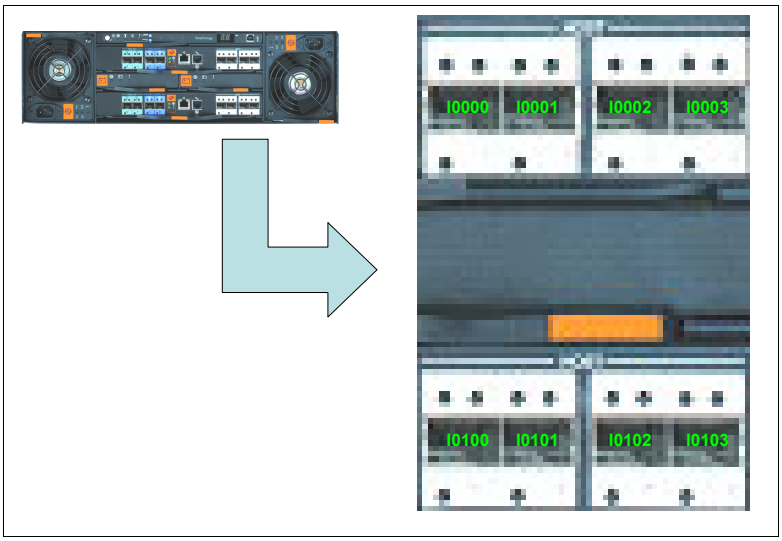

Figure 18-4 DS6800 I/O port numbers

The I/O ports can be configured for Fibre Channel protocol or FICON protocol. For Global Copy paths, you need at least one Fibre Channel connection between the two DS6000 subsystems. For higher availability, it is recommended that you use at least two Fibre Channel connections between the two subsystems on different controller cards on the DS6800.

The Fibre Channel ports used for Global Copy can be used as dedicated ports, which means that they will only be used for the Global Copy paths. Alternatively, they can be shared between Global Copy and Fibre Channel data traffic, but you must also have Fibre Channel switches for connectivity.

For supported SAN switches, refer to the DS6000 Interoperability Matrix.

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18.7 Global Copy connectivity

Global Copy pairs are set up between volumes in LSSs, usually in different disk subsystems, and these are normally in separate locations. A *path* (or group of paths) needs to be defined between the source LSS and the target LSS. These *logical paths* are defined over *physical links* between the disk subsystems.

The physical link includes the host adapter in the source DS6000, the cabling, switches or directors, any wideband or long distance transport devices (DWDM, channel extenders, WAN), and the host adapters in the target disk subsystem. Physical links can carry multiple Global Copy logical paths, as shown in Figure 18-5.

Note: For Global Copy, the DS6000 supports Fibre Channel links only. To facilitate ease of testing, the DS6000 does support Global Copy source and target on the same DS6000.

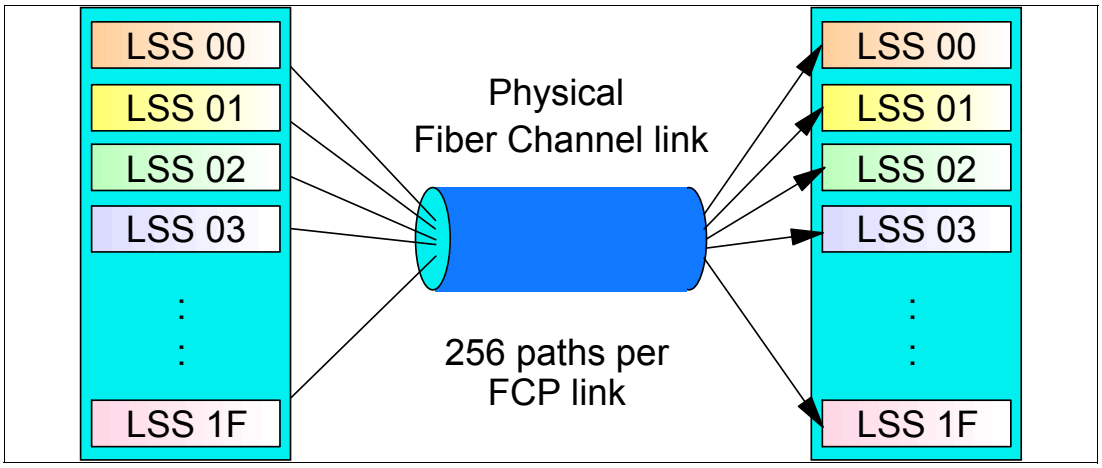

Figure 18-5 Logical paths and physical links

Paths are *unidirectional*, that is, they are defined to operate in either one direction or the other. Global Copy is *bidirectional*; that is, any particular pair of LSSs can have paths defined among them that have opposite directions—each LSS holds both source and target volumes from the other LSS. Moreover, opposite direction paths are allowed to be defined on the same Fibre Channel physical link.

For bandwidth and redundancy, more than one path can be created between the same LSSs. Global Copy will balance the workload across the available paths between the source and target LSSs.

Note: Remember that the LSS is not a physical construct in the DS6000; it is a logical construct. Volumes in an LSS can come from multiple disk arrays.

Physical links are bidirectional and can be shared by other Global Copy pairs as well as other remote mirror and copy functions, such as Metro Mirror and Global Mirror.

18.7.1 Fibre Channel links

We recommend that you read the discussion presented in 13.4.1, “Fibre Channel links” on page 143, in the Metro Mirror chapter, because it is also valid for Global Copy.

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18.7.2 Logical paths

We recommend that you read the discussion presented in 13.4.2, “Logical paths” on page 144, in the Metro Mirror chapter, because it is also valid for Global Copy.

18.8 Distance considerations

The maximum distance for a direct Fibre Channel connection is 10 km. If you want to use Global Copy over longer distances, the following connectivity technologies can be used to extend this distance:

- Fibre Channel switches
- Channel Extenders over Wide Area Network (WAN) lines
- Dense Wave Division Multiplexors (DWDM) on dark fibre

Channel extender

Channel extender vendors connect DS6000 systems with a variety of Wide Area Network (WAN) connections, including Fibre Channel, Ethernet/IP, ATM-OC3, and T1/T3.

When you use channel extender products with Global Copy, the channel extender vendor determines the maximum distance supported between the primary and secondary DS6000. Contact the channel extender vendor for their distance capability, line quality requirements, and WAN attachment capabilities.

A complete and current list of Global Copy supported environments, configurations, networks, and products is available in the DS6000 Interoperability Matrix.

Consult the channel extender vendor about hardware and software prerequisites if you are using their products in a DS6000 Global Copy configuration. Evaluation, qualification, approval, and support of Global Copy configurations using channel extender products is the sole responsibility of the channel extender vendor.

Dense Wave Division Multiplexor (DWDM)

Wave Division Multiplexing (WDM) and Dense Wave Division Multiplexing (DWDM) comprise the basic technology of fibre optical networking. The technique is used to carry many separate and independent optical channels on a single dark fibre.

A simple way to envision DWDM is to consider that, at the primary end, multiple fibre optic input channels (such as ESCON, Fibre Channel, FICON, or Gbit Ethernet) are combined by the DWDM into a single fibre optic cable. Each channel is encoded as light for a different wavelength. Think of each individual channel as an individual color: the DWDM system is transmitting a rainbow.

At the receiving end, the DWDM fans out the different optical channels. DWDM, by the very nature of its operation, provides the full bandwidth capability of the individual channel. As the wavelength of light is, from a practical perspective, infinitely divisible, DWDM technology is only limited by the sensitivity of its receptors, as the total aggregate bandwidth possible.

A complete and current list of Global Copy supported environments, configurations, networks, and products is available in the DS6000 Interoperability Matrix.

Contact the DWDM vendor regarding hardware and software prerequisites when using their products in an DS6000 Global Copy configuration.

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18.9 Other planning considerations

Figure 18-6 illustrates the use of Global Copy for point-in-time backup solutions.

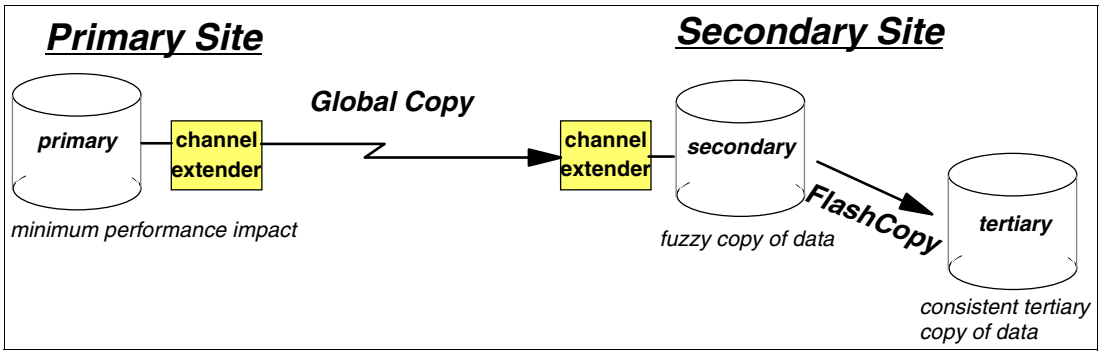

Figure 18-6 Global Copy environment

When you are planning to use Global Copy for point-in-time backup solutions, and if you are going to have tertiary copies, then within the target disk subsystem you should have an available set of volumes ready to become the FlashCopy target.

If your next step is to move the tertiary volumes onto tapes, then you must ensure that the tape resources are capable of handling these dump operations in between the point-in-time checkpoints, unless you have additional sets of volumes ready to become alternate FlashCopy targets.

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Global Copy performance and scalability

In this chapter, we discuss performance and scalability considerations when using Global Copy for DS6000.

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19.1 Performance

As the distance between DS6000s increases, Metro Mirror response time is proportionally affected, and this negatively impacts the application performance. When implementations over extended distances are needed, Global Copy becomes an excellent trade-off solution.

You can estimate the impact of Global Copy on an application as that of the application when working with Metro Mirror suspended volumes. For the DS6000, there is more work to do with the Global Copy volumes, as compared to the suspended volumes, because with Global Copy, the changes have to be sent to the remote DS6000. But this is a negligible overhead for the application, as compared with the typical synchronous overhead.

No processor resources (CPU and memory) are consumed by your Global Copy volume pairs, as this is managed by your DS6000 subsystem.

19.1.1 Peak bandwidth requirements

When you are researching your Global Copy link bandwidth requirements, you need to find the *peak sustained write rate* - remember that only writes will be mirrored across to the secondary volumes. For a typical z/OS system, this peak is usually reached during batch processing, when many updates are occurring. It could be higher still during month-end or year-end processing. You need to make allowances for this peak period when performing your bandwidth calculations.

19.2 Scalability

The DS6000 Global Copy environment can be scaled up or down as required. If new volumes are added to the DS6000 that require mirroring, they can be dynamically added. If additional Global Copy paths are required, they also can be dynamically added.

19.2.1 Addition of capacity

As previously mentioned, the logical nature of the LSS has made a Global Copy implementation on the DS6000 easier to plan, implement, and manage.

However, if you need to add more LSSs to your Global Copy environment, your management and automation solutions should be set up to handle this. The GDPS and eRCMF service offerings are designed to provide this functionality; see Part 8, “Solutions” on page 431, for more information. Also visit the IBM Web site and see the Services & Industry Solutions page.

Adding capacity to the same DS6000

If you are adding capacity into an existing DS6000, and providing that your Global Copy link bandwidth is not close to or over its limit, you might only need to add volume pairs into your configuration. If you are adding more LSSs, then you will need to define Global Copy paths before adding volume pairs. Keep in mind that when you add capacity for Global Copy use, you might have to acquire a new license feature code for Global Copy that corresponds to the new capacity.

Adding capacity to new DS6000s

If you are adding new DS6000s into your configuration, you must add physical links before defining your Global Copy paths and volume pairs. A minimum of two Global Copy paths per DS6000 pair is recommended for redundancy reasons. Your bandwidth analysis can indicate if you require more than two paths.

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Global Copy interfaces

The setup of Global Copy can be done using different interfaces. This chapter explains and gives examples of the interfaces that can be used for Global Copy management when Global Copy is used with the IBM System Storage DS6000 in System z environments.

The information discussed in this chapter can be complemented with the following:

- Chapter 3, “DS Storage Manager” on page 17
- Chapter 4, “DS Command-Line Interface” on page 25
- Chapter 5, “System z interfaces” on page 37

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20.1 Global Copy interfaces - overview

There are various interfaces available for the setup and management of Global Copy for DS6000 in a System z environment.

- For z/OS and OS/390, the following interfaces can be used:
  - TSO commands
  - ICKDSF utility
  - ANTRQST application programming interface (API)
  - DS6000 interfaces
- For z/VM:
  - ICKDSF utility
  - DS6000 interfaces
- For VSE:
  - ICKDSF utility
  - DS6000 interfaces
- For TPF:
  - ICKDSF utility
  - TPF itself
  - DS6000 interfaces
  - Other attached servers that support control of Global Copy

The following DS6000 interfaces can be used with all of the previously-listed operating systems:

- DS Command-Line Interface (DS CLI). The DS CLI can be used to invoke Global Copy commands from a server that supports the DS CLI (for example, a Windows XP server), provided that the server has appropriate connectivity to the DS6000 DS SMC.
- DS Storage Manager (DS SM) Graphical User Interface (DS SM GUI). The DS SM provides a graphical user interface (GUI) running in a Web browser that communicates with the DS6000 Storage Management Console (DS SMC).
- DS Open Application Programming Interface (DS Open API).

In this chapter we provide an overview of the z/OS interfaces, as well as the DS CLI and the DS SM Graphical User Interface. These interfaces are also covered in more detail in Part 2, “Interfaces” on page 15.

The DS Open Application Programming Interface (DS Open API), which is a set of application programming interfaces that are available to be integrated in programs, can be used for Global Copy management and control. Coverage of the DS Open API is beyond the scope of this IBM Redbook. For information on the DS Open API, refer to *IBM System Storage DS Open Application Programming Interface Reference*, GC35-0516.

Similar functions of the interfaces for Global Copy management

Note: The command set used for Global Copy management is the same as for Metro Mirror. As you will see with the explanations and examples we present, what differs are the parameters that are passed to the commands, as well as the selections made in the panels.

Table 20-1 on page 223 lists similar commands and panel selections of the various interfaces for Global Copy management, and the resulting tasks.

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Table 20-1 Comparison of commands

Task	TSO	ICKDSF	Command with DS CLI	Select option with DS SM
Global Copy paths commands				
List available I/O ports that can be used to establish Global Copy paths.			lsavailpprcport	This information is shown during the process when a path is established.
List established Global Copy paths.	CQUERY PATH	PPRCOPY QUERY PATHS	lspprcpath	Copy Services → Paths
Establish path	CESTPATH	PPRCOPY ESTPATH	mkpprcpath	Copy Services → Paths → Create
Delete path	CDELPATH	PPRCOPY DELPATH	rmpprcpath	Copy Services → Paths → Delete
Global Copy pairs commands				
Failback	CESTPAIR ACTION(FAILBACK)	PPRCOPY ESTPAIR FAILBACK	failbackpprc	Copy Services → Global Copy → Recover Failback
Failover	CESTPAIR ACTION(FAILOVER)	PPRCOPY ESTPAIR FAILOVER	failoverpprc	Copy Services → Global Copy → Recover Failover
List Global Copy volume pairs	CQUERY	PPRCOPY QUERY	lspprc	Copy Services → Global Copy
Establish pair	CESTPAIR	PPRCOPY ESTPAIR	mkpprc	Copy Service → Global Copy → Create
Suspend pair	CSUSPEND	PPRCOPY SUSPEND	pausepprc	Copy Services → Global Copy → Suspend
Resume pair	CESTPAIR MODE(RESYNC)	PPRCOPY ESTPAIR MODE(RESYNC)	resumepprc	Copy Services → Global Copy → Resume
Delete pair	CDELPAIR	PPRCOPY DELPAIR	rmpprc	Copy Services → Global Copy → Delete
Freeze Consistency Group	CGROUP FREEZE	PPRCOPY FREEZE	freezepprc	
Thaw Consistency Group	CGROUP RUN	PPRCOPY RUN	unfreezepprc	

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20.2 TSO commands for Global Copy management

In z/OS systems, Global Copy can be managed using TSO commands. In this section, we discuss the Global Copy commands that TSO provides. For a detailed description of these commands, see the IBM publication *z/OS DFSMS Advanced Copy Services,* SC35-0428.

20.2.1 Commands summary and use

A summary of the available TSO commands for Global Copy management and their corresponding use is presented in Table 20-2.

Table 20-2 TSO commands

Command	Description
CESTPAIR	Establishing Global Copy volume pairs
CESTPATH	Establish Global Copy path
CDELPAIR	Deleting volume pairs
CDELPATH	Deleting paths
CGROUP	Controlling volume groups with FREEZE and RUN
CQUERY	Querying of the status of volumes and paths
CRECOVER	Recovering data on the recovery system
CSUSPEND	Suspending Global Copy volume pairs

20.2.2 CESTPAIR

This command has the optional OPTION parameter, which has two mutually exclusive values: SYNC or XD. Specify SYNC if you want to establish Metro Mirror (synchronous) pair. Specify XD if you want to establish a Global Copy pair.

In order for the pair to become a Global Copy pair (in addition to specifying the XD value for the OPTION parameter), also specify whether this pair comes from the simplex or from the suspended state. That is, whether this is an initial copy of a newly established pair, or if it is a re-synchronization of a suspended pair. To indicate this, use the MODE parameter to specify either COPY or RESYNC, respectively.

Example 20-1 shows the CESTPAIR command with the OPTION parameter value XD and MODE parameter value of COPY. This example illustrates a transition from a simplex volume state to a copy pending volume state.

Example 20-1 Establish a Global Copy pair

```
CESTPAIR DEVN(X'6030') OPTION(XD) MODE(COPY) ONLINSEC(NO) -
PRIM(X'2060' AAGXA X'30' X'00') -
SEC(X'0002' AAVCA X'30' X'00')
```

Table 20-3 on page 225 summarizes the values of the CESTPAIR command parameters that you use when working with Global Copy pairs. Refer also to Table 20-3 for the parameter values for a go-to-sync transition.

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Table 20-3 CESTPAIR parameter

Operation	Volume pair state		CESTPAIR parameter values	
	from	**to**	**OPTION**	**MODE**
Establish initial copy pair	*simplex*	*copy pending*	XD	COPY
Re-establish suspended pair	*suspended*	*copy pending*	XD	RESYNC

20.2.3 CESTPATH

When establishing a path between DS6000s for Global Copy, use the CESTPATH command. There must be a physical Fibre Channel connection between the two DS6000 subsystems. You need to know the SSID, World Wide Node Name (WWNN), and LSS number for the primary and secondary DS6000s. These can be displayed with the CQUERY command.

Example 20-2 show how to use the CESTPATH command to establish a Global Copy path.

Example 20-2 CESTPATH command

```
CESTPATH DEVN(6030) CGROUP(NO) -
PRIM(X'2060' 500507630EFFFC6F X'00') -
SEC(X'0002' 500507630EFFFCA0 X'00') -
LINK(X'00000000')
```

20.2.4 CDELPAIR

The CDELPAIR command is used to specify the primary and secondary volumes to be removed from a Global Copy pairing. This command should be directed to the primary device as shown in Example 20-3.

Example 20-3 CDELPAIR command

```
CDELPAIR DEVN(X'6030') -
PRIM(X'2060' AAGXA X'30' X'00') -
SEC(X'0002' AAVCA X'30' X'00')
```

Before issuing a CDELPAIR command, verify that there are some active paths between the respective primary and secondary LSSs. If all of the paths that were established between both LSSs have been disabled, the CDELPAIR command will fail. After the failing CDELPAIR command times out, the state of the primary volume is simplex. The secondary volume remains in its previous state (duplex, pending, or suspended). You then need to give a CRECOVER command to return the secondary volume to the simplex state.

20.2.5 CDELPATH

The CDELPATH command is used to delete established Global Copy paths between a primary LSS and the corresponding secondary LSS as shown in Example 20-4 on page 226. Only the paths to the specified secondary LSS are affected; all other paths to other LSSs are not affected.

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Example 20-4 CDELPATH command

```
CDELPATH DEVN(X'6030') -
PRIM(X'2060' 500507630EFFFC6F X'00') -
SEC(X'0002' 500507630EFFFCA0 X'00') -
```

Before issuing a CDELPATH command, a CDELPAIR command to all Global Mirror and Copy volume pairs should be given. The CDELPATH command may cause an ANTP0121I message if this sequence is not followed.

20.2.6 CGROUP

The CGROUP command is used to control operations for multiple Global Copy volume pairs on a given LSS:

CGROUP FREEZE Stops all host application I/O to the primary volumes on the specified LSS pair. With the FREEZE parameter, remote mirror and copy volume pairs are suspended and paths for the specified LSS pair are deleted.

If the Global Copy paths for the LSS pair were defined with Consistency Group enabled (CGROUP parameter of the CESTPATH command), then an *extended long busy condition* is initiated when CGROUP FREEZE is issued for the LSS. All host application I/O to the primary is held off with a long busy condition for two minutes, or until a CGROUP command is issued with the RUN option. During the extended long busy window, update activity cannot proceed in the LSS where the freeze was done.

CGROUP RUN Resumes host application I/O for primary and secondary volumes of the LSS pair identified in the CGROUP command, which were previously halted with a CGROUP FREEZE command. The CGROUP RUN command is used to reset the extended long busy condition set by CGROUP FREEZE, and release application I/O to the primary volumes. The status of the volumes does not change; the primary volumes remain suspended.

Tip: The CGROUP FREEZE command deletes the paths between the specified LSS pair. To restart normal Global Copy operation, the paths must be reestablished and, if the I/O activity on the primary volumes was not interrupted during the freeze, the pairs must be re-synchronized.

Example 20-5 illustrates the CGROUP command.

Example 20-5 CGROUP command

```
CGROUP DEVN(X'1142') PRIM(X'6060' 62019 X'00') SEC(X'8060' 68006 X'00') FREEZE
CGROUP DEVN(X'1142') PRIM(X'6060' 62019 X'00') SEC(X'8060' 68006 X'00') RUN
```

Note: A single LSS can be paired with up to four other LSSs. Therefore, you might have to issue up to four CGROUP commands to suspend all pairs on a single primary LSS.

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20.2.7 CQUERY

The CQUERY command is used to query the status of one volume of a Global Copy volume pair or all paths that are associated with the LSS for the device number that is specified. The CQUERY command can be issued to either a primary or secondary Global Copy volume. A host system that is attached only to a primary volume cannot obtain the status of the secondary volume for that pair. In the same way, a host attached only to the secondary volume cannot obtain the status of the primary volume.

In Example 20-6, a CQUERY VOLUME command for volume 6030 is issued. The VOLUME parameter is the default, so it does not have to be specified.

Example 20-6 CQUERY command

```
CQUERY DEVN(X'6030')
```

The output of the CQUERY command, as shown in Example 20-7, provides volume-related information, such as SSID, CCA, LSS number, and DS6000 serial number. The TSO CQUERY command output for a Global Copy pair returns the *duplex-pending* state and the number of out-of-sync tracks.

Example 20-7 CQUERY command

```
ANTP8802I CQUERY DEVN(X'6030')
ANTP0090I CQUERY FORMATTED LVL 3 161
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  PENDING.XD   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  -------------------                     *
*   1   0000 0000   13    PATH ESTABLISHED...                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
*       ---- ----   00    NO PATH............                     *
* IF STATE = PENDING/SUSPEND:    TRACKS OUT OF SYNC =   30548      *
*                                TRACKS ON VOLUME   =   50085      *
*                               PERCENT OF COPY COMPLETE =  40%    *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------            -----------            *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                   *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
```

The number of out-of-sync tracks, tracks on volume, and percent of copy complete are not displayed if all tracks are in sync. Path information is displayed only when the CQUERY VOLUME command is issued to the primary volume.

20.2.8 CRECOVER

The CRECOVER command is used to allow the recovery system to gain control of the volumes. This command is issued from the recovery system to the secondary volume. It signals the recovery Storage Image to force the secondary volume into simplex state.

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During this procedure, the volume serial number can be verified and optionally relabeled. The volume can be varied online after this command is complete.

Example 20-8 CRECOVER command

```
CRECOVER DEVN(X'2242') -
PRIM('X6060' 62019 X'42' X'00') -
SEC(X'8061' 68006 X'42' X'00') -
ID(VOL002 VOL001) -
MSGREQ(YES)
```

In Example 20-8, the CRECOVER command brings device x'2242' (on the recovery DS6000) to simplex state. It also changes the volume label from VOL002 to VOL001.

20.2.9 CSUSPEND

This command is used to suspend Global Copy operations between a volume pair. Global Copy stops mirroring data to the secondary volume and starts keeping a record of the primary volume tracks that are updated. The information of which tracks were updated while the pair was suspended is used later, when the pair is reestablished, to copy just the updated tracks. In Example 20-9, a CSUSPEND command is issued for Global Copy primary volume 6030.

Example 20-9 CSUSPEND command

```
CSUSPEND DEVN(X'6030') -
PRIM(X'2060' AAGXA X'30' X'00') -
SEC(X'0002' AAVCA X'30' X'00')
```

20.2.10 Batch execution of Global Copy TSO commands

Batch procedures can be automated to manage some Global Copy activities. JCL can be used to issue Global Copy commands in batch jobs, and automation procedures can be set to watch for their completion. Automation could analyze the results from previous job executions or Global Copy messages, and then schedule other jobs to be executed. Example 20-10 illustrates a batch job for executing a Global Copy TSO command.

Example 20-10 Batch job for executing Global Copy commands

```
//IKJEFT01 JOB MSGLEVEL=(1,1),MSGCLASS=A,NOTIFY=user id
//STEP1 EXEC PGM=IKJEFT01
//SYSTSPRT DD SYSOUT=*
//SYSTSIN DD *
CDELPATH DEVN(X'E12B') -
PRIM(X'1071' 5005076300BBBBBB X'01') -
SEC(X'1710' 5005076303AAAAAA X'00')
```

20.3 ICKDSF utility for Global Copy management

In System z environments, the ICKDSF utility offers a means for control of Global Copy functions. ICKDSF typically runs as a batch program, and so can be automatically run from batch scheduling products (for example, Tivoli Workload Scheduler). It also supports VM and VSE systems.

Table 20-4 on page 229 lists the ICKDSF commands you can use for Global Copy management.

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Table 20-4 ICKDSF commands

Command	Description
PPRCOPY ESTPATH	Establishes Global Copy paths between a primary and secondary LSS
PPRCOPY DELPATH	Deletes Global Copy paths between primary and secondary LSSs
PPRCOPY ESTPAIR	Establishes a Global Copy primary-to-secondary volume relationship
PPRCOPY DELPAIR	Deletes a volume pair
PPRCOPY RECOVER	Allows a system to regain control of a volume on the secondary DS6000
PPRCOPY SUSPEND	Puts a Global Copy volume pair in suspended state
PPRCOPY FREEZE	Suspends all Global Copy operations at the LSS level
PPRCOPY RUN	Resumes I/O operations after a freeze with extended long busy
PPRCOPY QUERY	Queries the status of a Global Copy volume pair and the status of paths

Detailed explanation for each of the ICKDSF commands, as well as examples, are included in 14.3, “ICKDSF” on page 157.

For a detailed description of the ICKDSF commands, refer to *Device Support Facilities User’s Guide and Reference*, GC35-0033.

20.4 DS Command-Line Interface (DS CLI)

Although the DS CLI will not run on a System z processor, you can still use it to manage copy services operations on mainframe disks if you have a supported server environment (for example, Windows XP). The DS CLI can be used to create scripts for setup and control of DS6000 functions. It is a flexible and powerful interface.

In this section, we give an overview of the available DS CLI commands that you can use for Global Copy. For detailed information, refer to *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922.

DS CLI supported environments

The DS CLI is supported on the operating systems listed below, at the time of writing:

- AIX
- HP-UX
- HP Tru64
- Linux
- Novell Netware
- OpenVMS
- OS/400, i5/OS
- Sun Solaris
- Windows

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For the most current list of DS CLI supported environments, refer to the Interoperability Matrix that is found at the IBM Products site at:

http://www-03.ibm.com/servers/storage/disk/ds6000/interop.html

20.4.1 Define Global Copy paths

You can use the following commands to define and manage Global Copy paths.

lsavailpprcport

The **lsavailablepprcport** command displays the Fibre Channel ports, which can be used to establish Global Copy paths, see Example 20-11.

Example 20-11 lsavilpprcport command

```
dscli> lsavailpprcport -l -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA -remotewwnn
500507630EFFFCA0 16:16

Date/Time: June 14, 2005 9:36:35 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
Local Port Attached Port Type Switch ID Switch Port
=================================================
I0000      I0000         FCP  NA        NA
I0000      I0100         FCP  NA        NA
I0100      I0000         FCP  NA        NA
I0100      I0100         FCP  NA        NA
```

lspprcpath

The **lspprcpath** command shows you the defined paths from an LSS. Example 20-12 lists the paths from LSS 16.

Example 20-12 lspprcpath command

```
dscli> lspprcpath -dev IBM.1750-13AAGXA 16

Date/Time: June 14, 2005 9:46:31 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
Src Tgt State   SS   Port  Attached Port
=======================================
16  16  Success FF16 I0000 I0000
16  16  Success FF16 I0100 I0100
```

mkpprcpath

With the **mkpprcpath** command, you can define paths between two LSSs. In Example 20-13, we establish a path from 1750-13AAGXA/LSS 16/I/O port I0000 to 1750-13AAVCA/LSS 16/I/O port I0100.

Example 20-13 mkpprcpath command

```
dscli> mkpprcpath -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA -remotewwnn
500507630EFFFCA0 -srclss 16 -tgtlss 16 I0000:I0100

Date/Time: June 14, 2005 10:00:48 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00149I mkpprcpath: Remote Mirror and Copy path 16:16 successfully established.
```

rmpprcpath

The **rmpprcpath** command removes all paths between two LSSs; see Example 20-14 on page 231.

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Example 20-14 rmpprcpath command

```
dscli> rmpprcpath -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA 16:16
Date/Time: June 12, 2005 5:58:25 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00152W rmpprcpath: Are you sure you want to remove the Remote Mirror and Copy path
16:16:? [y/n]:y
CMUC00150I rmpprcpath: Remote Mirror and Copy path 16:16 successfully removed.
```

You can suppress the CMUC00152W confirmation message by adding the **-quiet** parameter to the command.

20.4.2 Manage Global Copy pairs

You can use the following commands to establish and manage Global Copy pairs.

failbackpprc

You can use the **failbackpprc** command against any Global Copy source volume that is in a suspended state. The command copies the required data from the source volume to the target volume in order to resume mirroring, as shown in Example 20-15. The command is usually used after a **failoverpprc** command has been given to restart mirroring either in the reverse direction (recovery site-to-production site) or original direction (production site-to-recovery site).

Example 20-15 failbackpprc command

```
dscli>failbackpprc -dev IBM.1750-13AAVCA -remotedev IBM.1750-13AAGXA 1600:1600
Date/Time: June 14, 2005 1:40:22 PM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAVCA
CMUC00197I failoverpprc: Remote Mirror and Copy pair 1610:1610 successfully failed back.
```

failoverpprc

You can use the **failoverpprc** command to change a target device into a (source) suspended device while leaving the original source device in its current state; see Example 20-16.

Example 20-16 failoverpprc command

```
dscli> failoverpprc -dev IBM.1750-13AAVCA -type mmir -remotedev IBM.1750-13AAGXA 1610:1610
Date/Time: June 14, 2005 1:40:22 PM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAVCA
CMUC00196I failoverpprc: Remote Mirror and Copy pair 1610:1610 successfully reversed.
```

lspprc

The **lspprc** command shows you which volumes are in a Global Copy relationship; see Example 20-17.

Example 20-17 lspprc command

```
dscli> lspprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA -l 1600
Date/Time: June 14, 2005 11:28:35 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
ID        State        Reason Type        Out Of Sync Tracks Tgt Read Src Cascade Tgt
Cascade Date Suspended               SourceLSS Timeout (secs) Critical Mode First Pass
Status
==========================================================================================
1600:1600 Copy Pending -      Global Copy 0                Disabled Disabled    Disabled
Wed Dec 31 17:59:59 CST 1969 16        300           Disabled      True
```


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mkpprc

With the **mkpprc** command, you can create a Global Copy pair. To create a Global Copy pair, specify parameter **-type gcp**, as shown in Example 20-18.

Example 20-18 mkpprc command

```
dscli> mkpprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA -type gcp -mode full
1600:1600
Date/Time: June 14, 2005 11:25:49 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 1600:1600 successfully
created.
```

freezepprc

With the **freezepprc** command you can stop the write activity on all Global Copy primary and secondary volumes of a given source and target LSS pair; see Example 20-19.

The command creates a new Consistency Group. It places the source logical subsystem (LSS) in the long busy state so that no I/Os can be directed to it. It sets the primary volumes on the source LSS in suspended state. Secondary volumes are left in their current state.

The command also removes paths between the source LSS and target LSS, and sets the extended long busy condition for the primary volume. This causes the host to queue writes to the primary volume until the long busy condition is reset (with the **unfreezepprc** command). During the long busy condition, the primary volume reports long busy status.

Example 20-19 freezepprc command

```
dscli> freezepprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA 16:16
Date/Time: June 14, 2005 5:45:52 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00161W freezepprc: Remote Mirror and Copy consistency group 16:16 successfully created.
```

pausepprc

The **pausepprc** command suspends a Global Copy pair; see Example 20-20.

Example 20-20 pausepprc command

```
dscli> pausepprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA 1600:1600
Date/Time: June 14, 2005 12:36:16 PM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00157I pausepprc: Remote Mirror and Copy volume pair 1600:1600 relationship
successfully paused.
```

resumepprc

With the **resumepprc** command, you can bring a pair from suspended to copy pending mode, as shown in Example 20-21.

Example 20-21 resumepprc command

```
dscli> resumepprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA -type gcp 1600:1600
Date/Time: June 14, 2005 12:41:25 PM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00158I resumepprc: Remote Mirror and Copy volume pair 1600:1600 relationship
successfully resumed. This message is being returned before the copy completes.
```

rmpprc

The **rmpprc** command removes the relationship from a Global Copy pair and sets the volumes in simplex status; see Example 20-22 on page 233.

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Example 20-22 rmpprc command

```
dscli> rmpprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA 1600:1600
Date/Time: June 14, 2005 12:48:09 PM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00160W rmpprc: Are you sure you want to delete the Remote Mirror and Copy volume pair
relationship 1600:1600:? [y/n]:y
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 1600:1600 relationship successfully
withdrawn.
```

You can suppress the CMUC00160W confirmation message by adding the **-quiet** parameter.

unfreezepprc

With the **unfreezepprc** command, you can *thaw* an existing Consistency Group; see Example 20-23. It resumes host application I/O activity for primary volumes on the Consistency Group that was created by an earlier **freezepprc** command.

The **unfreezepprc** command is used to reset the extended long busy condition for the primary volume and release application I/O to the primary volumes. All queued writes to the source volume are written. The status of the volumes does not change; the primary volumes remain in the suspended state as set by the **freezepprc** command.

Example 20-23 unfreezepprc command

```
dscli> unfreezepprc -dev IBM.1750-13AAGXA -remotedev IBM.1750-13AAVCA 16:16
Date/Time: June 14, 2005 5:46:37 AM CDT IBM DSCLI Version: 5.0.3.110 DS: IBM.1750-13AAGXA
CMUC00198I unfreezepprc: Remote Mirror and Copy pair 16:16 successfully thawed.
```

Note: Because the **freezepprc** command deletes the paths between the specified LSS pair, you have to reestablish them to resume normal Global Copy operation.

20.5 DS Storage Manager

The DS Storage Manager (DS SM) is a graphical user interface (GUI) that can be used to set up and control Global Copy. It is user friendly, however, you cannot use it for automation activities, and certain remote mirror and copy functions are not supported from this interface.

In this section we give examples of common tasks that are performed using the DS SM.

20.5.1 Paths panel

The Path panel is the central point in the DS Storage Manager to establish new paths and manage existing paths. You can get to the path panel as follows:

1. Select **Real-time manager**.
2. Select **Copy Services**.
3. Click **Paths**.

Then the Paths panel will display; see Figure 20-1 on page 234. Here, to display existing paths, select the storage unit and the LSS for which you want to display the paths information.

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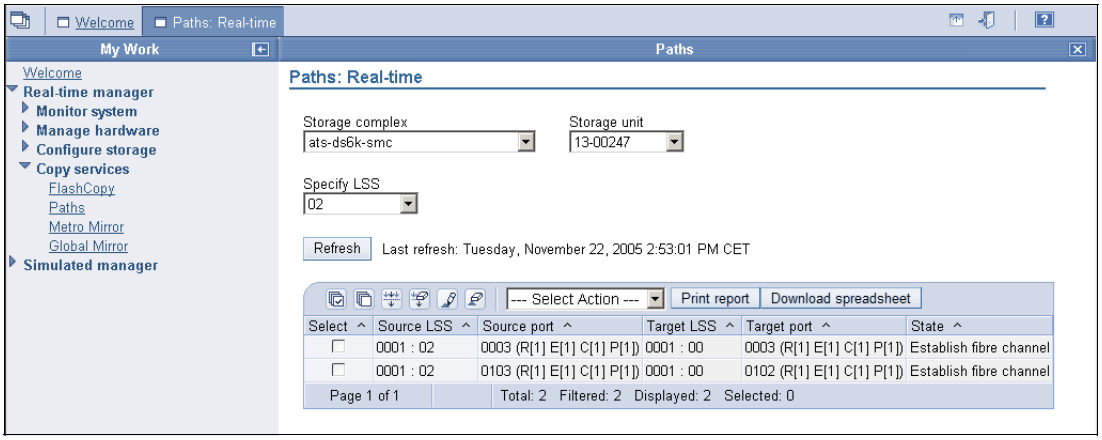

Figure 20-1 Paths panel

To create a new path, select from the Select Actions pull-down menu **Create**, and a process will then guide you to establishing a path.

Alternatively, if in the Paths panel you select one or more of the existing paths, then the Select Actions pull-down menu will give you the following additional possible actions:

- **Delete**, to delete the paths you have selected before.
- **LSS copy options**, to modify the copy options for an LSS; see Figure 20-2.

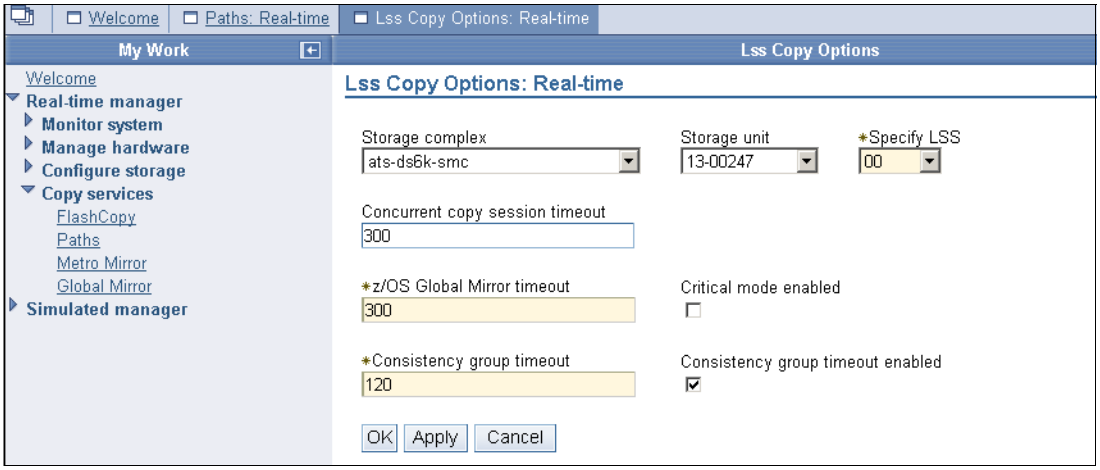

Figure 20-2 LSS Copy Options

20.5.2 Metro Mirror panel

The Metro Mirror panel is the central point in the DS Storage Manager to establish new and manage existing Global Copy pairs. You can get to the Metro Mirror panel as follows:

1. Select **Real-time manager**.
2. Select **Copy services**.
3. Click **Metro Mirror**.

Figure 20-3 on page 235 shows the Metro Mirror panel.

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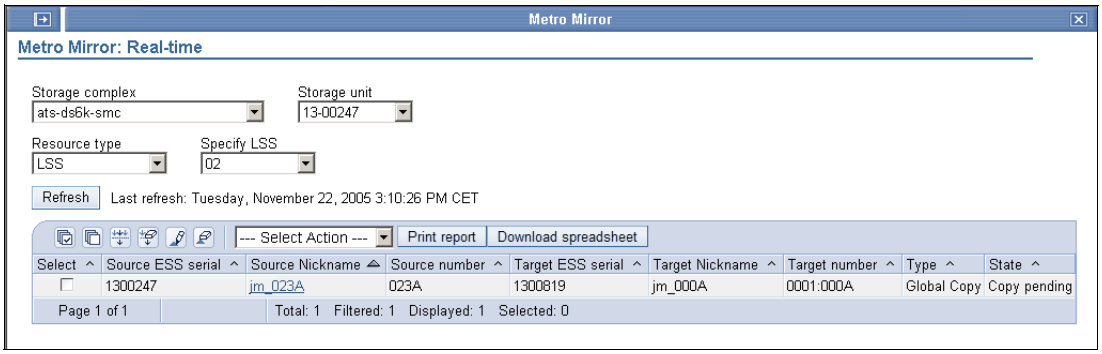

Figure 20-3 Metro Mirror panel

To create a new Global Copy pair, choose **Create** from the Select Action pull-down menu. The DS Storage Manager will guide you through the process to create a new pair.

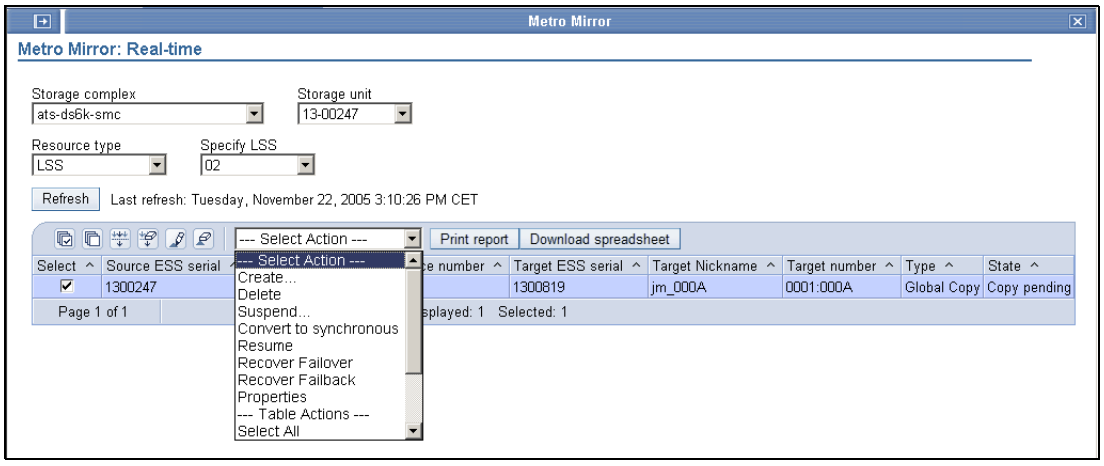

Figure 20-4 Metro Mirror panel

If you select an existing Global Copy pair (see Figure 20-4), then the Select Action pull-down menu will show additional actions you can perform with the selected volume pair:

- **Delete**: Use this action to delete a Global Copy pair.
- **Suspend**: Use this action to suspend a Global Copy pair.
- **Convert to synchronous**: Use this action to convert a Global Copy pair into a synchronous Metro Mirror pair.
- **Resume**: Use this option to resume a suspended Global Copy pair.
- **Recover Failover**: Use this action to change a secondary device into a primary suspended device while leaving the primary device in its current state.
- **Recover Failback**: Use this action to switch back to the primary site after a failover.
- **Properties**: Use this action to view the volume pair properties, including the number of out-of-sync tracks.

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21

Global Copy examples

This chapter includes sample Global Copy scenarios and examples of the corresponding management activities using TSO and the DS CLI. The examples presented are:

- How to establish and manage Global Copy volume pairs with TSO
- Use Global Copy to migrate volumes from an ESS 800 to a DS6000 using the DS CLI

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21.1 Define and manage Global Copy pairs using TSO

Figure 21-1 shows a diagram of the test environment that we used for our example.

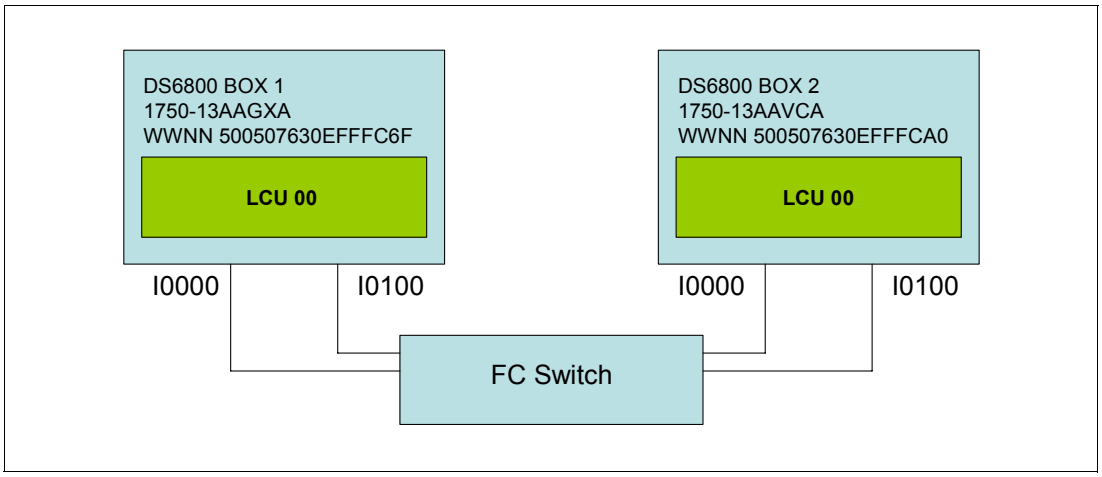

Figure 21-1 Configuration used to setup Global Copy pairs in our example

In our example, using TSO commands, we established a path between two LSSs and then established the Global Copy pairs. After the pairs were established, we re-synchronized the volumes. After the volumes were synchronized, we suspended the volumes. To do this we followed this procedure:

1. We established a path with the CESTPATH command; see Example 21-1.

Example 21-1 CESTPATH command

```
CESTPATH DEVN(6030) PRIM(X'2060' 500507630EFFFC6F X'00') -
         SEC(X'0002' 500507630EFFFCA0 X'00') -
         LINK(X'00000000') -
         CGROUP(NO)
```

To establish paths with TSO, we had to specify the WWNN from the storage subsystems. We used the CQUERY PATHS command to determine the SSID and WWNN of the primary and secondary LSSs. The WWNN can also be found by using the DS GUI or with DS CLI `lssi` command. The WWNN for the DS6800 in our example are shown in Figure 21-1.

2. We established two Global Copy pairs with the CESTPAIR command; see Example 21-2.

Example 21-2 CESTPAIR command

```
CESTPAIR DEVN(X'6030') PRIM(X'2060' AAGXA X'30' X'00') -
         SEC(X'0002' AAVCA X'30' X'00') -
         OPTION(XD) MODE(COPY) ONLINSEC(NO)
CESTPAIR DEVN(X'6031') PRIM(X'2060' AAGXA X'31' X'00') -
         SEC(X'0002' AAVCA X'31' X'00') -
         OPTION(XD) MODE(COPY) ONLINSEC(NO)
```

To establish a Global Copy pair, we used the (XD) option. After the pairs are established, we were able to query the state of the volumes with the CQUERY command. We did this for one volume, as shown in Example 21-3 on page 239.

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Example 21-3 CQUERY command

```
ANTP8802I CQUERY DEVN(X'6030')
ANTP0090I CQUERY FORMATTED LVL 3 161
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  PENDING.XD   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   1   0000 0000   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
* IF STATE = PENDING/SUSPEND:    TRACKS OUT OF SYNC =   30548      *
*                                TRACKS ON VOLUME   =   50085      *
*                               PERCENT OF COPY COMPLETE =  40%    *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFC6F           5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                  *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
```

The output of the CQUERY command shows that the volume is in pending state and also shows the number of tracks out of sync. When the write activity on the primary volume is stopped, all data is eventually copied over to the secondary. The status remains **pending.xd** but the number of out of sync tracks is zero. We verified this with the CQUERY command (Example 21-4).

Example 21-4 QUERY command

```
ANTP8802I CQUERY DEVN(X'6030')
ANTP0090I CQUERY FORMATTED LVL 3 161
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  PENDING.XD   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   1   0000 0000   13    PATH ESTABLISHED...                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
*       ---- ----   00    NO PATH............                      *
* IF STATE = PENDING/SUSPEND:    TRACKS OUT OF SYNC =   00000      *
*                                TRACKS ON VOLUME   =   50085      *
*                               PERCENT OF COPY COMPLETE = 100%    *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------            *
* PRIMARY....  500507630EFFFC6F           5.0.00.0000            *
* SECONDARY.1  500507630EFFFCA0                                  *
********************************************************************
```


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```
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
```

3. After the volumes were fully copied, we suspended the pairs; see Example 21-5.

Example 21-5 CSUSPEND Global Copy pair

```
ANTP8802I CSUSPEND DEVN(X'6030') PRIM(X'2060' AAGXA X'30' X'00')
   SEC(X'0002' AAVCA X'30' X'00')
ANTP0001I CSUSPEND COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
IEA494I 6030,DS6030,PPRC PAIR SUSPENDED,SSID=2060,CCA=30

ANTP8802I CSUSPEND DEVN(X'6031') PRIM(X'2060' AAGXA X'31' X'00')
   SEC(X'0002' AAVCA X'31' X'00')
ANTP0001I CSUSPEND COMMAND COMPLETED FOR DEVICE 6031. COMPLETION CODE: 00
IEA494I 6031,DS6031,PPRC PAIR SUSPENDED,SSID=2060,CCA=31
```

4. We could verify whether the volumes were suspended with the CQUERY command. State SUSPEND(3) means that the Global Copy volume pair was suspended by a host command to the primary site storage control. In Example 21-6, we show the results for device 6030.

Example 21-6 CQUERY command

```
ANTP8802I CQUERY DEVN(X'6030')
ANTP0090I CQUERY FORMATTED LVL 3 351
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                          (PRIMARY)   (SECONDARY) *
*                                         SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 6030  PRIMARY..  SUSPEND(3)   ACTIVE..   2060 30 00   0002 30 00 *
*       CRIT(NO).......       CGRPLB(NO). 0000000AAGXA 0000000AAVCA*
* PATHS PFCA SFCA STATUS: DESCRIPTION                               *
* ----- --------- ------  -------------------                       *
*   1   0000 0000   13    PATH ESTABLISHED...                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*       ---- ----   00    NO PATH............                       *
*  SUBSYSTEM         WWNN                  LIC LEVEL               *
* -----------  ----------------            -----------             *
* PRIMARY....  500507630EFFFC6F            5.0.00.0000             *
* SECONDARY.1  500507630EFFFCA0                                    *
********************************************************************
ANTP0001I CQUERY COMMAND COMPLETED FOR DEVICE 6030. COMPLETION CODE: 00
```

5. After the pairs were suspended, we resumed the I/O on the primary site and made a FlashCopy on the secondary site. We made an inband FlashCopy of the secondary volumes using the FCESTABL command; see Example 21-7. We requested inband FlashCopy with the REMOTE(YES) parameter. The DEVN parameter specifies the address of the Global Copy primary volume. The SOURCE and TARGET parameters specify the FlashCopy source and target volumes. SSID is the Subsystem Identifier of the FlashCopy source volume. This must be the same value as that specified for SSID of the secondary device on the PPRC CESTPAIR command.

Example 21-7 Make FlashCopy

```
FCESTABL DEVN(6030) SOURCE(AAVCA 00 30) TARGET(AAVCA 00 40) REMOTE(YES) -
SSID(0002) MODE(COPY)
FCESTABL DEVN(6031) SOURCE(AAVCA 00 31) TARGET(AAVCA 00 41) REMOTE(YES) -
```


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```
SSID(0002) MODE(COPY)
```

6. The final task was to reestablish Global Copy for the volume pairs; see Example 21-8.

Example 21-8 Restart Global Copy

```
CESTPAIR DEVN(X'6030') PRIM(X'2060' AAGXA X'30' X'00') -
          SEC(X'0002' AAVCA X'30' X'00') -
          OPTION(XD) MODE(RESYNC)
CESTPAIR DEVN(X'6031') PRIM(X'2060' AAGXA X'31' X'00') -
          SEC(X'0002' AAVCA X'31' X'00') -
          OPTION(XD) MODE(RESYNC)
```

21.2 Global Copy for migration using the DS CLI

In this example, we show how to use DS CLI commands and scripts to migrate volumes from an ESS 800 to a DS6000 using Global Copy. In the example, we have only two volumes. In reality, you would perform the steps for a larger number of volumes. In that case, DS CLI scripts are particularly useful because the commands can be written in advance and modified if necessary. Our example also shows the strength of the DS CLI in the management of CKD copy operations.

In the example, the source volumes are `050A` and `050B` on LSS `05` of the ESS 800 `IBM.2105-22399`. The target volumes are `023A` and `023B` on LSS `02` of the DS6000 `IBM.1750-1300247`.

The Web Copy Services commands for S/390 volumes ESS Control Switch has to be enabled on the ESS-800; otherwise, the DS CLI cannot be used to establish CKD volume pairs. If the control switch is disabled, the following message is issued: `CMUN03013E mkpprc: CKD management is disabled`. Contact your IBM service representative to enable the control switch. The control switch change should be followed by restart of the ESS Copy Services server.

21.2.1 Migration procedure steps

To use CLI commands and scripts to migrate volumes from an ESS 800 to a DS6000 with Global Copy, we followed this procedure.

1. We checked the WWNN of the target DS6000 system. Using the DS CLI in one-shot mode, we issued the **`lssi`** command; see Example 21-9. Profile `ds6-00247.prf` contains the necessary logon information for the DS6000 target system.

Example 21-9 Check target WWNN

```
C:\IBM\DSCLI>dscli -cfg ds6-00247.prf lssi
Date/Time: November 22, 2005 4:01:06 PM EET IBM DSCLI Version: 5.1.0.204
Name ID               Storage Unit     Model WWNN             State  ESSNet
==============================================================================
-    IBM.1750-1300247 IBM.1750-1300247 511   500507630EFFFE16 Online Enabled
```

2. We checked which FCP ports were available for establishing paths between LSS `05` on the ESS 800 and LSS `02` on the DS6000. We used the DS CLI in one-shot mode to issue the **`availpprcport`** command; see Example 21-10 on page 242. Profile ess-22399.prf contains the necessary logon information for the ESS 800 source system.

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Example 21-10 Check ports

```
C:\IBM\DSCLI>dscli -cfg ess-22399.prf lsavailpprcport -dev ibm.2105-22399 -remotedev
ibm.1750-1300247 -remotewwnn 500507630efffe16 05:02
Date/Time: November 22, 2005 4:08:10 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
Local Port Attached Port Type
============================
I000C      I0103         FCP
I00AC      I0003         FCP
```

3. We established paths from source LSS 05 to target LSS 02. The CLI script file to do this is shown in Example 21-11.

Example 21-11 Script estpath.cli

```
# Script to establish paths
mkpprcpath -dev ibm.2105-22399 -remotedev ibm.1750-1300247 -remotewwnn 500507630efffe16
-srclss 05 -tgtlss 02 i000c:i0103 i00ac:i0003
```

We executed the **estpath.cli** script file using CLI script mode and check path status using CLI one-shot mode; see Example 21-12.

Example 21-12 Establish paths

```
C:\IBM\DSCLI>dscli -cfg ess-22399.prf -script estpath.cli
Date/Time: November 22, 2005 4:14:05 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00149I mkpprcpath: Remote Mirror and Copy path 05:02 successfully established.

C:\IBM\DSCLI>dscli -cfg ess-22399.prf lspprcpath -dev ibm.2105-22399 05
Date/Time: November 22, 2005 4:15:24 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
Src Tgt State   SS   Port  Attached Port Tgt WWNN
=======================================================
05  08  Success 8000 I0088 I0002         5005076303FFC08F
05  06  Success 6000 I000C I0103         500507630EFFFE16
05  02  Success E200 I00AC I0003         500507630EFFFE16
05  02  Success E200 I000C I0103         500507630EFFFE16
```

Note that the **lspprcpath** command output also shows other paths in addition to the paths that we used.

4. To establish the Global Copy pairs, we first created the CLI script file; see Example 21-13.

Example 21-13 Script estpair.cli

```
# Script to establish Global Copy pairs
mkpprc -dev ibm.2105-22399 -remotedev ibm.1750-1300247 -type gcp -mode full 050a:023a
mkpprc -dev ibm.2105-22399 -remotedev ibm.1750-1300247 -type gcp -mode full 050b:023b
```

We executed the **estpair.cli** script and then checked the pair status; see Example 21-14.

Example 21-14 Establish pairs

```
C:\IBM\DSCLI>dscli -cfg ess-22399.prf -script estpair.cli
Date/Time: November 22, 2005 4:21:54 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 050A:023A successfully created.
Date/Time: November 22, 2005 4:22:08 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 050B:023B successfully created.

C:\IBM\DSCLI>dscli -cfg ess-22399.prf lspprc -dev ibm.2105-22399 -l 050a-050b
Date/Time: November 22, 2005 4:22:57 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
ID        State        Reason Type        Out Of Sync Tracks Tgt Read Src Cascade Tgt Casca
```


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```
================================================================================================
050A:023A Copy Pending -      Global Copy 48148              Disabled Unknown     Unknown
050B:023B Copy Pending -      Global Copy 50085              Disabled Unknown     Unknown
```

5. We synchronized the Global Copy pairs so that the target volume would be consistent. This should not be done until the number of out-of-sync tracks for most of the volumes is close to zero.

   Before this step is performed, the hosts using the volumes that are migrated should be shut down, because the pairs become synchronous Metro Mirror pairs. This can have an impact on application write response times. The script to synchronize the pairs is shown in Example 21-15.

Example 21-15 Script syncpair.cli

```
# Script to synchronize pairs
mkpprc -dev ibm.2105-22399 -remotedev ibm.1750-1300247 -type mmir 050a:023a
mkpprc -dev ibm.2105-22399 -remotedev ibm.1750-1300247 -type mmir 050b:023b
```

   We executed the `syncpair.cli` script and then checked that all pairs were in full duplex status; see Example 21-16.

Example 21-16 Synchronize pairs

```
C:\IBM\DSCLI>dscli -cfg ess-22399.prf -script syncpair.cli
Date/Time: November 22, 2005 4:42:20 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 050A:023A successfully created.
Date/Time: November 22, 2005 4:42:42 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 050B:023B successfully created.

C:\IBM\DSCLI>dscli -cfg ess-22399.prf lspprc -dev ibm.2105-22399 050a-050b
Date/Time: November 22, 2005 4:42:59 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
ID        State       Reason Type         SourceLSS Timeout (secs) Critical Mode First Pass
================================================================================================
050A:023A Full Duplex -      Metro Mirror 05        unknown        Disabled      Invalid
050B:023B Full Duplex -      Metro Mirror 05        unknown        Disabled      Invalid
```

6. To stop mirroring and return the target volumes to simplex state, we used the script shown in Example 21-17.

Example 21-17 Script delpair.cli

```
# Script to delete volume pairs
rmpprc -dev ibm.2105-22399 -remotedev ibm.1750-1300247 -quiet 050a:023a
rmpprc -dev ibm.2105-22399 -remotedev ibm.1750-1300247 -quiet 050b:023b
```

   We then executed the script and verified that the volume pairs had been removed; see Example 21-18.

   Before the pairs are deleted, all pairs should be in full duplex status.

Example 21-18 Delete volume pairs

```
C:\IBM\DSCLI>dscli -cfg ess-22399.prf -script delpair.cli
Date/Time: November 22, 2005 4:45:09 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 050A:023A relationship successfully
withdrawn.
Date/Time: November 22, 2005 4:45:24 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 050B:023B relationship successfully
withdrawn.

C:\IBM\DSCLI>dscli -cfg ess-22399.prf lspprc -dev ibm.2105-22399 050a-050b
```


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```
Date/Time: November 22, 2005 4:45:34 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00234I lspprc: No Remote Mirror and Copy found.
```

After the volume pairs have been deleted, the host systems can be IPLed from the target volumes on the DS6000 and the applications can start. To avoid duplicate volser messages and the related operator replies during IPL, physically disconnect the ESS 800 source system from the host, or change ESCON/FICON director configurations as relevant.

7. As a final clean-up step, we removed the paths between the ESS 800 and the DS6000. We did this using CLI in one-shot mode; see Example 21-19.

Example 21-19 Script delpath.cli

```
C:\IBM\DSCLI>dscli -cfg ess-22399.prf rmpprcpath -dev ibm.2105-22399 -remotedev
ibm.1750-1300247 -quiet 05:02
Date/Time: November 22, 2005 4:57:47 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00150I rmpprcpath: Remote Mirror and Copy path 05:02 successfully removed.

C:\IBM\DSCLI>dscli -cfg ess-22399.prf lspprcpath -dev ibm.2105-22399 05
Date/Time: November 22, 2005 4:58:25 PM EET IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
Src Tgt State   SS   Port  Attached Port Tgt WWNN
=======================================================
05  08  Success 8000 I0088 I0002         5005076303FFC08F
05  06  Success 6000 I000C I0103         500507630EFFFE16
```

Although this example was carried out with CKD volumes, the procedure applies equally well to open systems volumes, because the same DS CLI commands are used for open systems.

21.2.2 Cascading alternative

The preceding example assumes that the source volumes on the ESS 800 are simplex. However, they could also be secondary volumes of existing Global Copy or Metro Mirror pairs. In that case, we could set up a cascaded Global Copy relationship by specifying the **-cascade** parameter on the **mkpprc** command in step 4 of the previous example, as shown in Example 21-20.

Example 21-20 Establish cascaded pairs

```
C:\IBM\DSCLI>dscli -cfg ess-22399.prf mkpprc -dev ibm.2105-22399 -cascade
remotedev ibm.1750-1300247 -type gcp -mode full 050a:023a
Date/Time: November 25, 2005 10:28:17 AM EET IBM DSCLI Version: 5.1.0.204 DS:
IBM.2105-22399
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 050A:023A successfully created.

C:\IBM\DSCLI>dscli -cfg ess-22399.prf lspprc -dev ibm.2105-22399 050a
Date/Time: November 25, 2005 10:28:42 AM EET IBM DSCLI Version: 5.1.0.204 DS:
IBM.2105-22399
ID        State               Reason Type        SourceLSS Timeout (secs) Critical Mode Fir
==========================================================================================
011A:050A Target Copy Pending -      Global Copy 01        unknown        Disabled
050A:023A Copy Pending        -      Global Copy 05        unknown        Disabled
```

Here, 011A is the source volume, 050A is the intermediate volume, and 023A is the target volume. The **lspprc** command shows the status of both volume pairs where the intermediate volume 050A belongs. 011A:050A is the first pair where 050A is the secondary, and 050A:023A is the second pair where 050A is the cascading primary.

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22

Global Mirror overview

In this chapter we provide an overview of what Global Mirror is. We also discuss the need for data consistency at a distant site when synchronous data replication such as Metro Mirror is not possible. This chapter then explains how Global Mirror works in a similar manner to a distributed application—in a server and client relationship. Finally, in this chapter you will find a step-by-step process to establish a Global Mirror environment.

The information discussed in the present chapter can be complemented with the following IBM publications and redbooks:

- *z/OS DFSMS Advanced Copy Services*, SC35-0428
- *IBM System Storage DS6000 Series: Architecture and Implementation*, SG24-6781
- *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922

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22.1 Synchronous and non synchronous data replication

When replicating data over long distances, beyond the 300 km, asynchronous data replication is the valid approach. This is basically so because with the asynchronous techniques, the application I/O processing at the local storage disk subsystem (storage server) remains independent of the process of data transmission to the remote storage disk subsystem.

Still with the asynchronous data replication techniques, we need to provide additional means to ensure data consistency at the remote location. It even requires a solution that guarantees data consistency not only within a single local-remote pair of storage disk subsystems but also across multiple local and remote storage disk subsystems.

For a given pair of local and remote storage disk subsystems, a time stamp approach leads to consistent data at the remote storage disk subsystem. Using this approach, and by sorting the I/Os by their time stamps, the write I/Os can be applied at the remote disk subsystem in the same sequence as they arrived at the local disk subsystem.

But when the application volumes are spread across multiple storage disk subsystems, this time stamp concept alone is not sufficient to replicate data and provide data consistency at the remote site. This additionally requires a Consistency Group concept. z/OS Global Mirror, formerly known as XRC, is an example of such a solution and utilizes the concept of Consistency Groups combined with time stamped write I/Os for all involved primary volumes within a Consistency Group or session. See Part 6, “Global Mirror” on page 265 for more information regarding z/OS Global Mirror.

In the rest of the present section we discuss how consistent data, that is dependent writes, are managed either with a synchronous technique like Metro Mirror versus different asynchronous techniques like Global Copy or Global Mirror.

22.1.1 Synchronous data replication and dependent writes

In normal operations, the nature of synchronous data replication preserves data consistency for *dependent writes*—dependent writes and data consistency are explained in detail in Section 13.3, “Consistency Group function” on page 136.

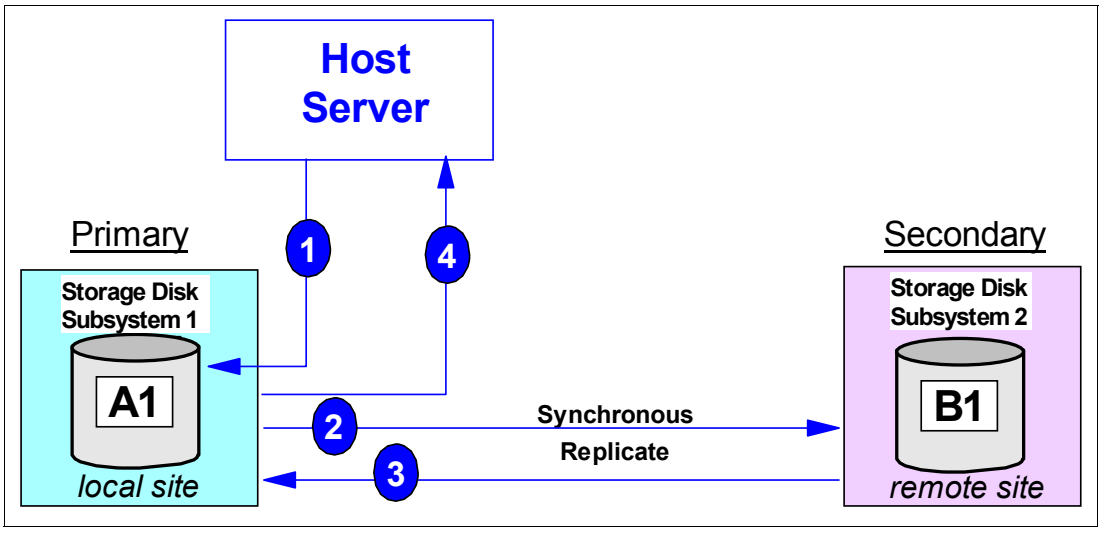

Figure 22-1 Synchronous data replication

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In synchronous data replication methods such as Metro Mirror, an application write always goes through the following four steps; see Figure 22-1 on page 246:

1. Write the data to the primary storage disk subsystem cache and present channel end to free up the channel for further I/O. Note this does not end the I/O and does not present an I/O complete to the application.
2. Replicate the data from the primary storage disk subsystem cache to the secondary storage disk subsystem cache.
3. Acknowledge to the primary storage disk subsystem that data successfully arrived at the secondary storage disk subsystem.
4. Present device end to acknowledge successful I/O completion to the server, which is presented to the application and concludes this I/O.

Now the next I/O that depends on the successful completion of the previous I/O can be issued.

When you have dependent writes across multiple storage disk subsystems, synchronous data replication alone does not guarantee that you can restart applications at the secondary site without doing some previous data recovery.

Consider a database environment that spreads across multiple storage disk subsystems at the local (primary) site. Further assume that the remote copy volume pairs are defined with CRIT(HEAVY), which used to be CRIT(YES), and the remote copy paths are not defined with the CGROUP parameter. Figure 22-2 illustrates what happens in this scenario during a disaster, and in the absence of any automation software in place to handle I/O exceptions.

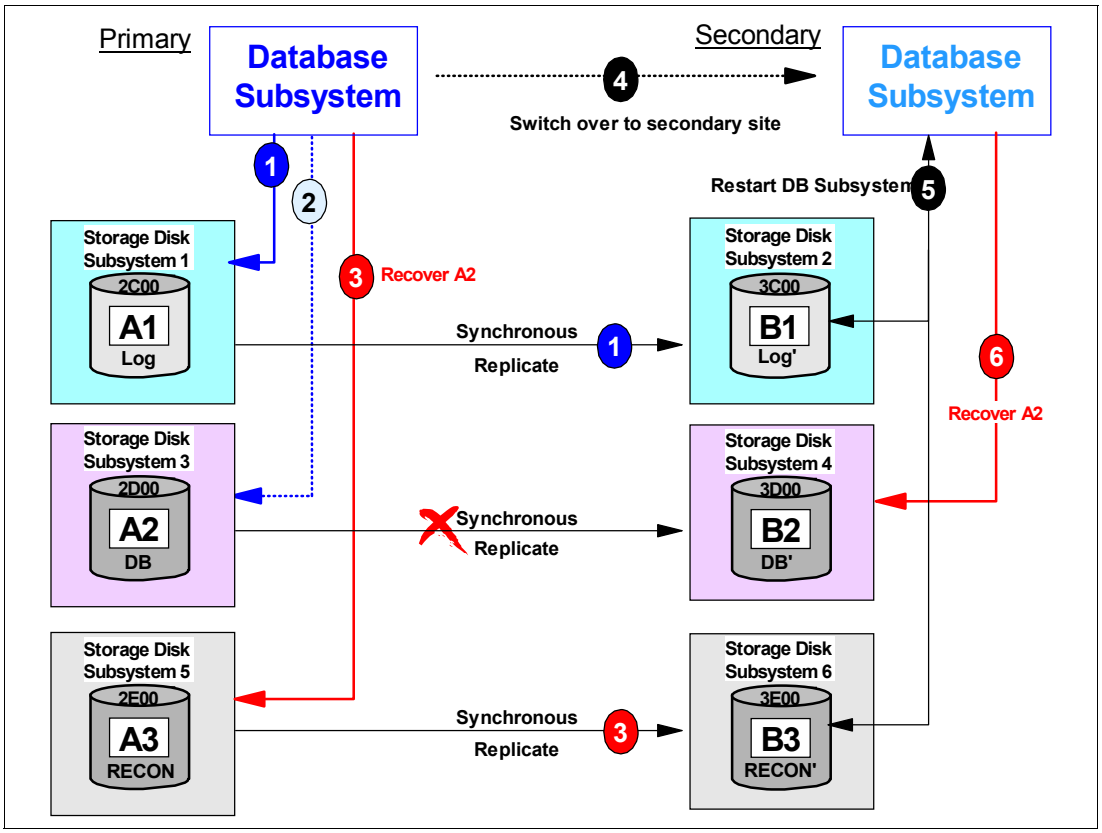

Figure 22-2 Synchronous data replication and unnecessary recovery after primary site failure

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A database update usually involves three dependent write I/Os to ensure data consistency, even in the event of a failure during this process:

1. Update intent to the logging files—logging may happen to two logging files.
2. Update the data.
3. Indicate update complete to the logging files.

This sequence of I/Os is also called a two phase commit process.

When you are in a remote copy environment, in an outage situation, the following sequence may occur; see Figure 22-2 on page 247:

1. Write update intent to logging volume A1.
2. Update to database on volume A2 eventually fails due to a replication problem from the primary site to the secondary site and volume pairs are defined with CRIT(HEAVY). This may also be a severe primary storage failure and the beginning of a rolling disaster.
3. The database subsystem recognizes the failed write I/O and indicates, in a configuration file on volume A3, that one or more databases on A2 have to be recovered due to an I/O error. This gets replicated to the secondary site because the paths for this storage disk subsystem pair are still working and this particular primary storage disk subsystem did not fail yet.
4. The failure eventually progressed and failed the primary site completely. The database subsystem is restarted at the secondary site after switching over to the secondary site.
5. At startup, the database subsystem discovers in its configuration file that the database on A2-B2 has to be recovered as indicated before. This is actually not necessary because the data was synchronously replicated and both related volumes, A2 and B2, are identical and at the very same level of data currency —that of the moment previous to the error. Nevertheless, the database subsystem will still recover all databases that are marked for recovery as per the information found in the configuration files on A3-B3.
6. This recovery is actually not necessary because the data in A2-B2 is perfectly in-sync due to the synchronous replication approach. Nonetheless, the recovery will take place because there was no automation window in place to freeze the configuration, which would have removed the necessary paths between the primary and the secondary sites, thus ensuring that no further I/Os continue to take place.

This does not happen with an automated solution such as GDPS, that makes use of the freeze capabilities of the IBM System Storage DS6000. Had GDPS been there, after failing over to the secondary site, the database subsystem would have just restarted without the necessity for a lengthy database recovery.

Figure 22-3 on page 249 illustrates a rolling disaster situation where we have an automation software that makes use of the freeze capability of the DS6000.

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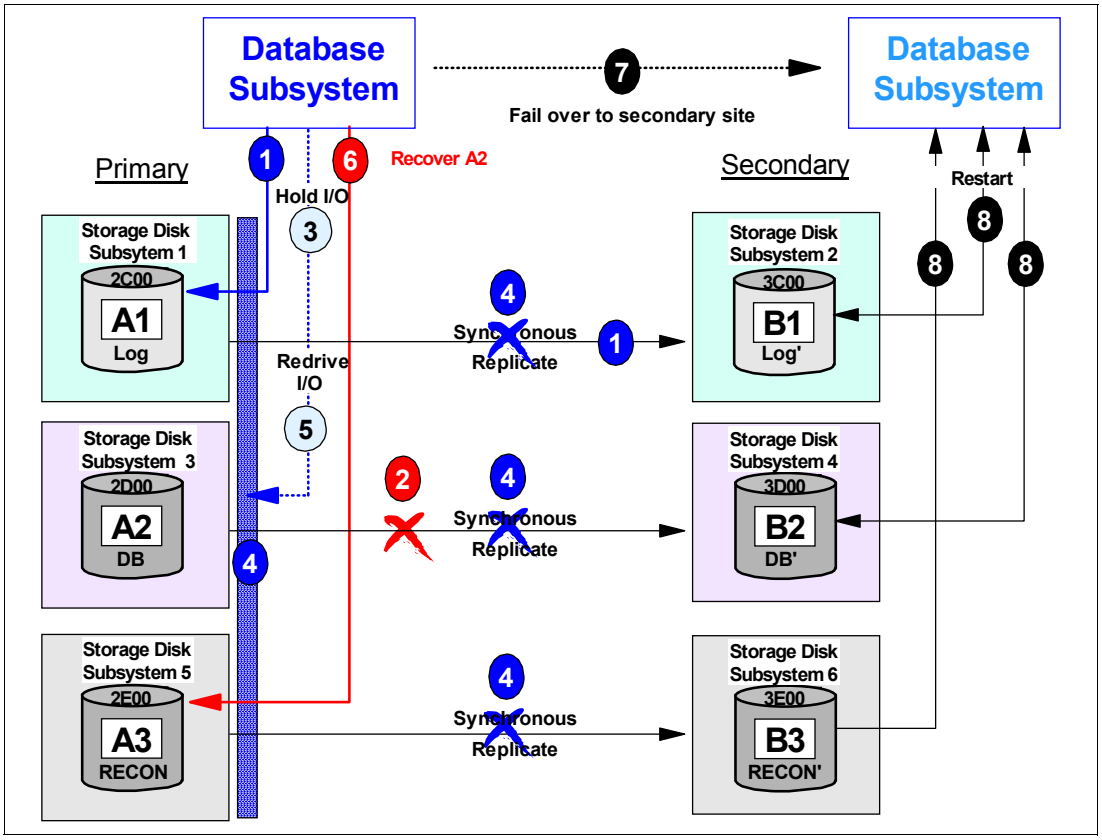

Figure 22-3 Synchronous data replication, freeze, and restart without recovery required

The sequence of events in Figure 22-3 is the following:

1. Update intent to logging file.
2. Link between A2 and B2 becomes unavailable, or the storage disk subsystem with A2 fails, and a rolling disaster develops.
3. The first attempt to write to the database volume A2 will return a unit check. The host re-drives the I/O. When only the links fail, the subsystem triggers an *extended long busy* (ELB). This is also called an *automation window*.
4. Within this automation window, or ELB window, a freeze operation removes all related paths between both sites for the selected LSSs. From now on, no data is replicated any longer between the selected LSSs.
5. After the ELB expires, or a RUN command is issued to end the freeze period, the I/O is re-driven, and it may successfully complete when the pair is suspended, or may fail when CRIT(HEAVY) is specified or the storage disk subsystem 3 is not available any longer.
6. When the I/O fails, then a *recovery required* is written to the database configuration file on A3. Note volume A3 is no longer replicated due to the previous freeze. Note also that volume A2 and B2 are still identical and at the very same level of data currency —that of the moment previous to the error.
7. The primary site eventually becomes unavailable and a switch over to the secondary site is carried out.
8. Database subsystem restart discovers *no recovery required* indication because all related data is consistent —neither the *recovery required* indication in step 6 was transmitted to B3. Then, the database subsystems continues immediately after the restart phase is finished.

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Summary

In summary, the following characteristics are typical of a synchronous data replication technique:

- Application write I/O response time is affected —this can be modeled and predicted.
- Local and remote copies of data are committed to both storage disk subsystems before host write I/O is complete.
- Data consistency is always maintained at the remote site as long as no failures occur. If a rolling disaster occurs, freeze/run is needed to maintain consistency.
- Bandwidth between both sites has to scale with the peak write I/O rate.
- Data at the remote site is always current.
- No extra means, such as additional journal volumes or tertiary copy, are required.
- A tier 7 solution is achieved with automation software such as GDPS.

This is different with an asynchronous data replication approach. We still require data consistency at a distant site in order to just restart at the distant site when the local site becomes unavailable.

22.1.2 Asynchronous data replication and dependent writes

In normal operations, for asynchronous data replication, data consistency for *dependent writes* will be preserved depending on the technique used to replicate the data—dependent writes and data consistency are explained in detail in Section 13.3, “Consistency Group function” on page 136. For example, Global Copy, that is explained in Part 5, “Global Copy” on page 199, and Global Mirror, that we are explaining now, use different techniques.

An asynchronous remote copy approach is usually required when the distance between the primary site and the secondary site is beyond an efficient distance for a synchronous remote copy solution. Metro Mirror provides an efficient synchronous approach for up to 300 km, when utilizing Fibre Channel links.

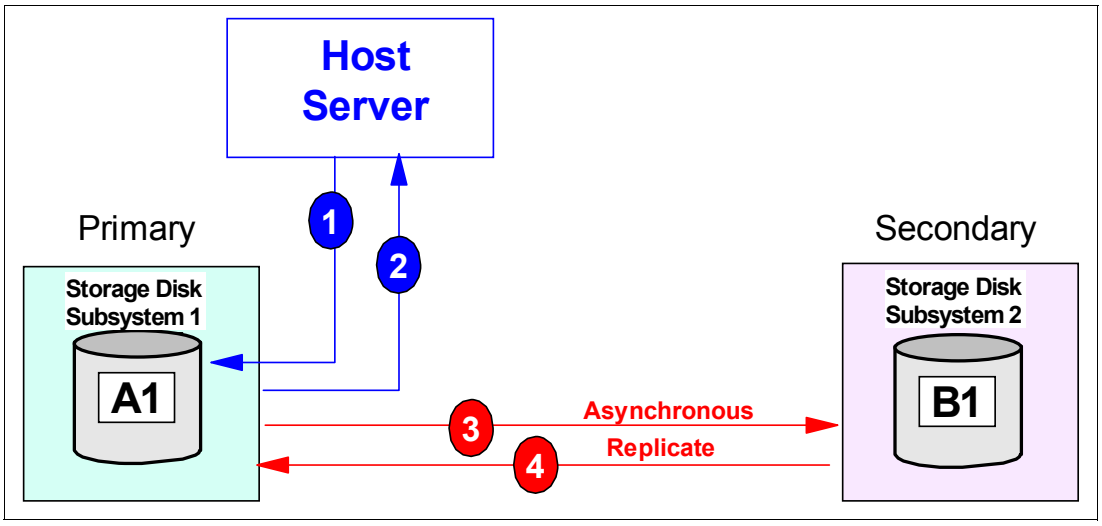

Figure 22-4 Asynchronous data replication

In an asynchronous data replication environment, an application write I/O goes through the following steps; see Figure 22-4:

1. Write application data to the primary storage disk subsystem cache.

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2. Present channel end and device end and acknowledge to the application successful I/O completion. The application can then immediately schedule the next I/O.
3. Replicate the data from the primary storage disk subsystem cache to the secondary storage disk subsystem cache.
4. Acknowledge to the primary storage disk subsystem that data successfully arrived at the secondary storage disk subsystem.

From the previous procedure, note how in an asynchronous type technique, the data transmission and the I/O completion acknowledge are independent process. This results in virtually no application I/O impact, or at most to a minimal degree only. This also derives its convenience when needing to replicate over long distances.

Global Copy non-synchronous technique

By its own, a non-synchronous technique like that of Global Copy, provides no guarantee that the sequence of arrival of the applications write I/Os to the primary volumes is preserved at the secondary site. In other words, the order of dependent writes is not preserved at the secondary site. This is illustrated in Figure 22-5.

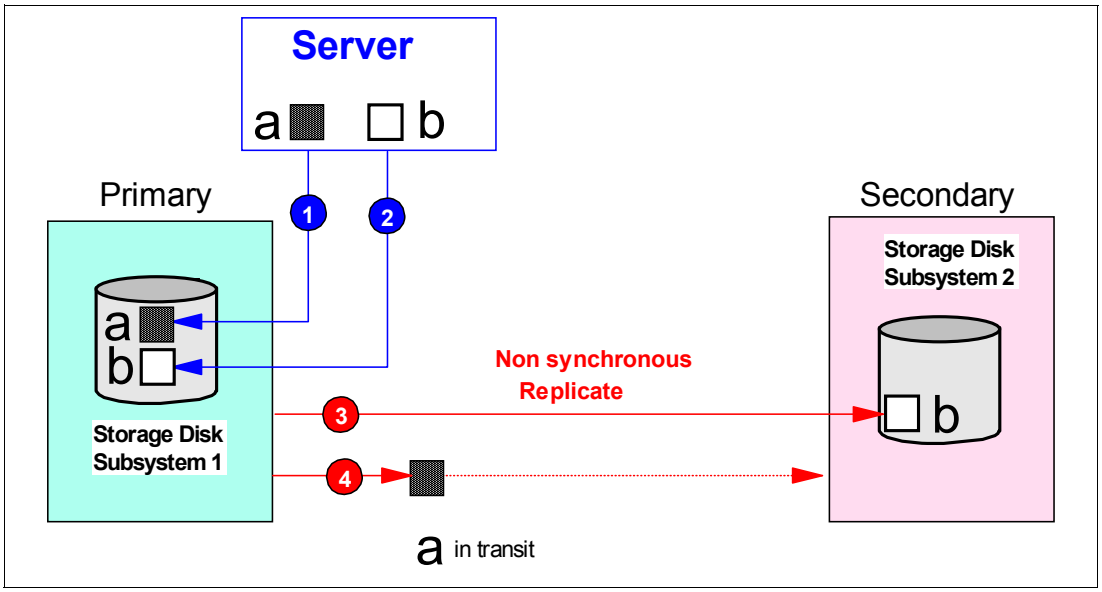

Figure 22-5 Global Copy sequence of data arrival not preserved at secondary site

Global Copy by itself as a non synchronous data replication method does not provide data consistency at the secondary site.

In Figure 22-5 the sequence of data arrival at the primary site is record **b** after record **a**. Due to the way Global Copy cycles through its out-of-sync bit map, it may replicate record **a** to the secondary site after record **b**. This assumes that, for example, record **a** is written to a primary disk location that the Global Copy replication cycle just passed before. Global Copy may approach another disk location that experienced just before an update with record **b**. Then record **b** gets replicated to the secondary site before the replication cycle starts from the beginning and finds record **a**.

This situation may get even worse when involving multiple storage disk subsystems at the primary site. As Figure 22-6 on page 252 shows, when using Global Copy, dependent writes are not preserved at the recovery site when a failure occurs. This characteristic happens both at a particular storage disk subsystem pair as well as across multiple storage disk subsystems.

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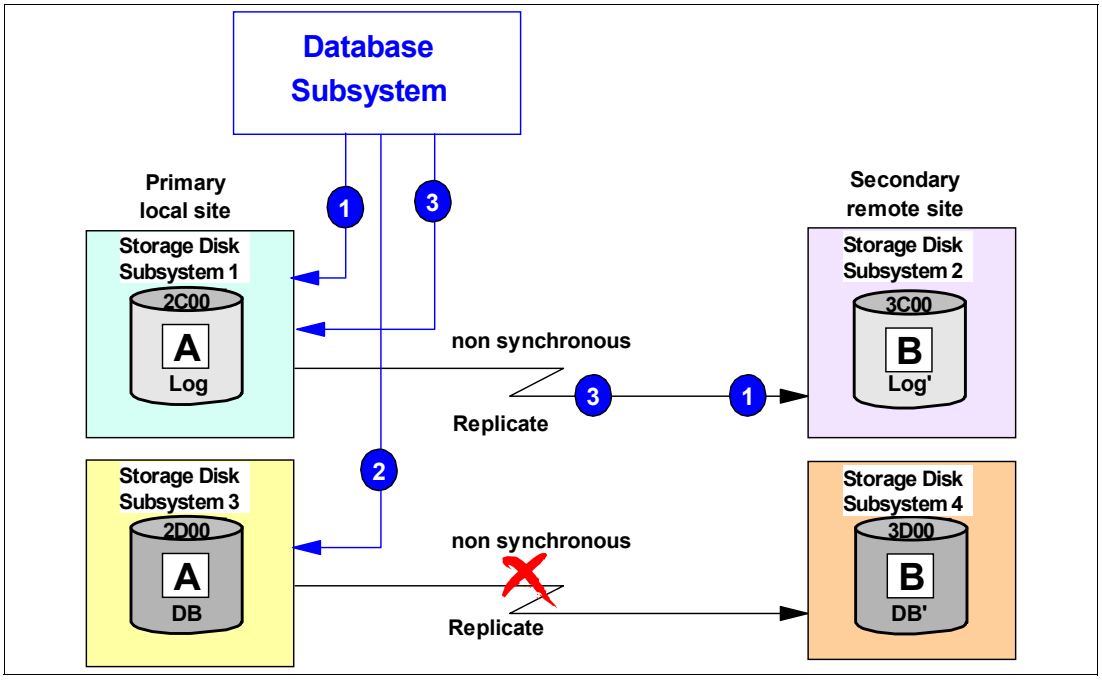

Figure 22-6 Global Copy non synchronous data replication involving multiple disk subsystems

Notice that the numbers in Figure 22-6 indicate the transfer of data as well as the sequence of its corresponding write I/Os. Record 3 may be replicated to storage disk subsystem 2 before record 1 arrives to storage disk subsystem 2. Record 2 may never make it to storage disk subsystem 4 due to the connectivity problem between storage disk subsystem 3 and storage disk subsystem 4, which in turn may be the beginning of a rolling disaster. So, when using a non synchronous technique like Global Copy, consistent data cannot be guaranteed at the remote site without any additional measures, functions, and procedures.

The challenge is to provide data consistency at the distant site at any time and independent of the combination of storage disk subsystems involved. One solution is to combine Global Copy with FlashCopy and create a three-copy solution. This requires a series of additional steps that have to be organized and carried out:

1. At the local site, temporarily pause the application write I/Os on the primary A volumes.
2. Wait for and make sure that the primary A volumes and the secondary B volumes become synchronized. Note the challenge to manage all volumes.
3. Using FlashCopy, create a point-in-time (PiT) copy of the B volumes at the remote site.
4. The FlashCopy targets, that is the C volumes, will then hold a copy of the A volumes at the time the application was paused or stopped. In this manner data consistency is kept at the remote site.
5. Restart or resume the application write I/O activity to the A volumes

Global Mirror asynchronous technique

If we could incorporate the previous five basic steps into the storage disk subsystem internal microcode, and we could count with the corresponding management interface, then this would basically be an efficient asynchronous mirroring technique that would allow the replication of data over long distances, without impacting the application I/O response time, its operation would be transparent and autonomic from the users point of view, and most importantly would provide a consistent copy of the data at the remote site at all times. All this is what basically Global Mirror is about.

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To accomplish the necessary activities with minimum impact on the application write I/O, Global Mirror introduces a smart bitmap approach in the primary storage disk subsystem. With this, Global Mirror can resume the application I/O processing immediately after a very brief serialization period for all involved primary storage disk subsystems —this brief serialization periodically occurs at the very beginning of a sequence of events that resemble the ones outlined above. In the following chapters we explain in detail the characteristics of Global Mirror, how it operates and how can you manage it.

Summary

In summary, the following characteristics are what an asynchronous data replication technique should provide:

- Data replication to the remote site independent from application write I/O processing at the local site. This derives in no impact, or at least only minimal impact, to the application local write I/O response time.
- Data consistency and dependent writes always maintained at the remote site.
- Data currency at remote site lags a little behind the local site. The remote site is always less current than the local site. In peak write workloads this difference is going to increase. This does not necessarily apply to XRC, which tries to throttle host write activity to keep the data currency gap to a minimum. This in turn has the potential of blocking the primary volumes from host write I/Os for a brief interval. Global Mirror as another asynchronous remote copy approach does not throttle host write I/Os.
- Bandwidth requirement between local and remote sites does not have to be configured for peak write workload—link bandwidth utilization is improved over synchronous solutions.
- Tertiary copies are required at the remote site to preserve data consistency.
- Data loss in disaster recovery situations is limited to the data in transit plus the data that may still be in the queue at the local site waiting to be replicated to the recovery site.

All the previous attributes are characteristics of Global Mirror.

22.2 Basic concepts of Global Mirror

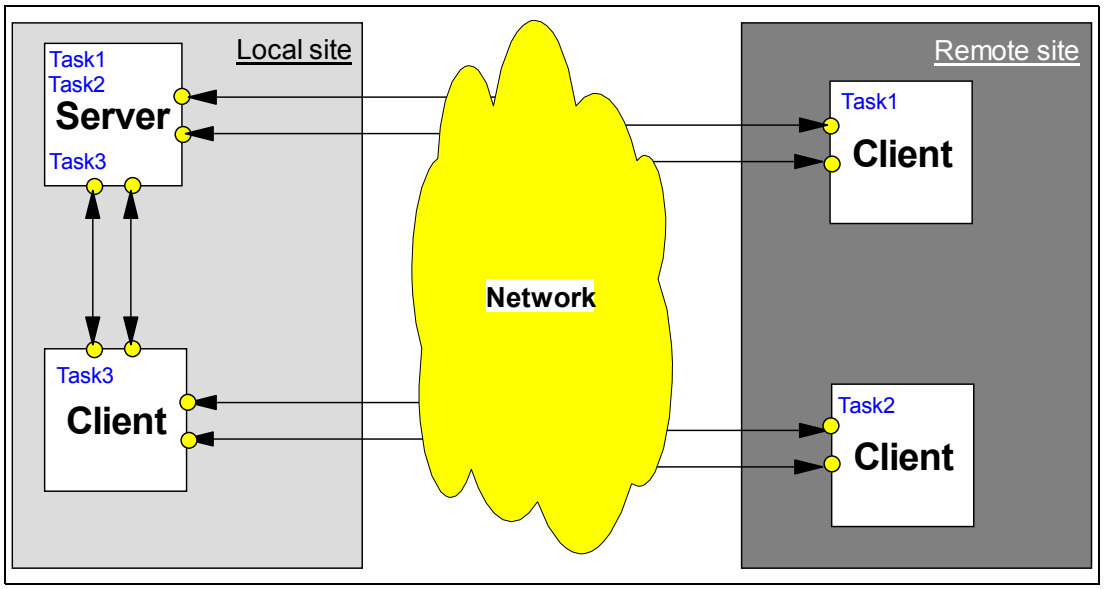

Figure 22-7 Distributed application

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Global Mirror works like a distributed application. A distributed application is usually built on a server to client relationship. The server functions as a supervisor and instructs the client. The client is able to do some work in an autonomic fashion but relies on the coordination efforts from the server; see Figure 22-7 on page 253.

The server distributes the work to its clients. The server also coordinates all individual feedback from the clients and decides based on this feedback further actions.

Looking at Figure 22-7 results obvious that the communication paths between the server and all its clients are key. Without communication paths between these four components the functions will eventually come to a complete stop. Matters get more complicated when the communication fails unexpectedly in the middle of information exchange between the server and his clients or to some of his clients.

Usually a two-phase commit process helps to provide a consistent state for certain functions and whether they have successfully completed at the client site. Once a function is successfully completed and is acknowledged to the server, the server progresses to the next function task. At the same time the server tries to do as much as possible in parallel to minimize the hit on throughput due to serialization and checkpoints.

When certain activities are dependent on each other it is required that the server coordinate these activities to ensure a proper sequence.

The server and client can be replaced by terms such as Master and Subordinate; see Figure 22-8. These terms are used later when discussing Global Mirror.

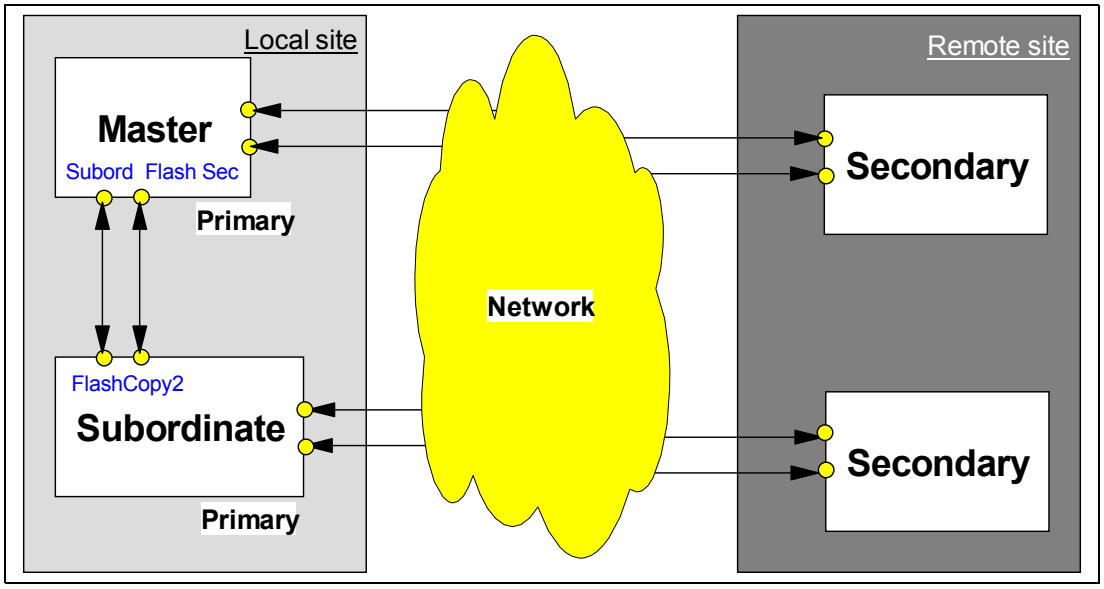

Figure 22-8 Global Mirror as a distributed application

Figure 22-8 shows the basic Global Mirror structure. A Master coordinates all efforts within a Global Mirror environment. Once the Master is started and manages a Global Mirror environment, the Master issues all related commands over inband communication to its attached subordinates at the local site. This may include a subordinate within the Master itself. This communication between the Master and an internal subordinate is transparent and does not need any extra attention from the user. The subordinates use inband communication to communicate with their related secondary storage disk subsystems at the remote site. The Master also receives all acknowledgements from his subordinates and their secondaries, and coordinates and serializes all the activities in the session.

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When the Master and Subordinate are in a single storage disk subsystem the Subordinate is internally managed by the Master. With two or more storage disk subsystems at the local site, which participate in a Global Mirror session, the Subordinate is external and needs separate attention when creating and managing a Global Mirror session or environment.

The following sections explain how Global Mirror works and how Global Mirror ensures consistent data at any time at the remote site. First we go through the process of how to create a Global Mirror environment. At the same time, this explanation, gives us a first insight on how Global Mirror works.

22.3 Set up a Global Mirror session

Global Mirror, as a long distance remote copy solution, is based on an efficient combination of Global Copy and FlashCopy functions. It is the microcode that provides, from the user perspective, a transparent and autonomic mechanism to intelligently utilize Global Copy in conjunction with certain FlashCopy operations to attain consistent data at the remote site.

In order to understand how Global Mirror works, we start explaining first how a Global Mirror environment, that is a Global Mirror session, is created and started. This is a step-by-step approach and helps to understand further the Global Mirror operational aspects.

22.3.1 Simple configuration to start

In order to understand each step and to show the principles, we start with a simple application environment where a host makes write I/Os to a single application volume (A); see Figure 22-9.

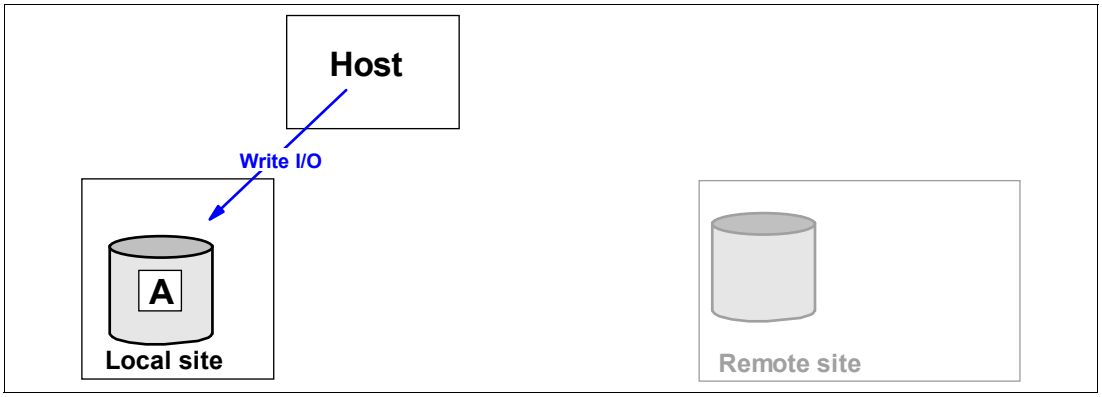

Figure 22-9 Start with simple application environment

22.3.2 Establish connectivity to remote site

Now we add a distant site which has a storage disk subsystem (B), and we want to interconnect both sites; see Figure 22-10 on page 256.

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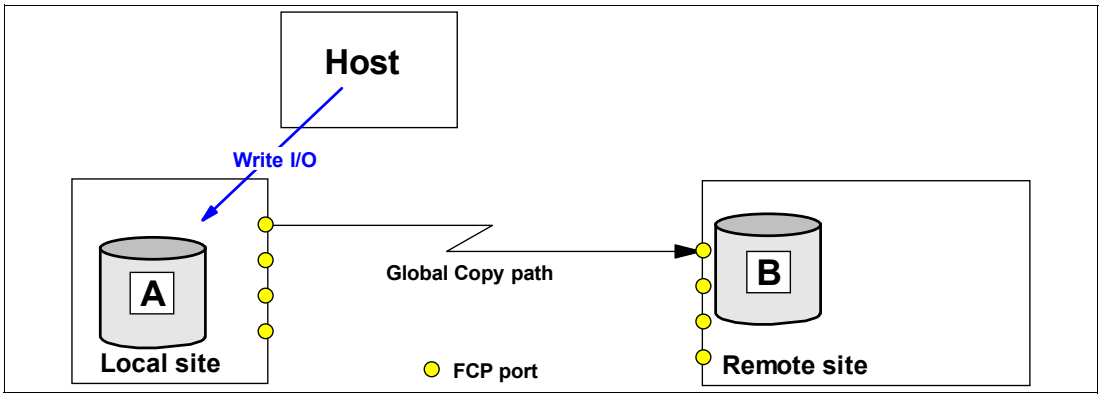

Figure 22-10 Establish Global Copy connectivity between both sites

Note in Figure 22-10that we establish Global Copy paths over an existing network. This network may be based on a FCP transport technology or on an IP based network.

Global Copy paths are logical connections that are defined over the physical links that interconnect both sites. Note that all remote mirror and copy paths (that is Metro Mirror, Global Copy, and Global Mirror paths) are similar and are based on FCP. The term Global Copy path just denotes that the path is intended for Global Copy use.

22.3.3 Create Global Copy relationship between local and remote volume

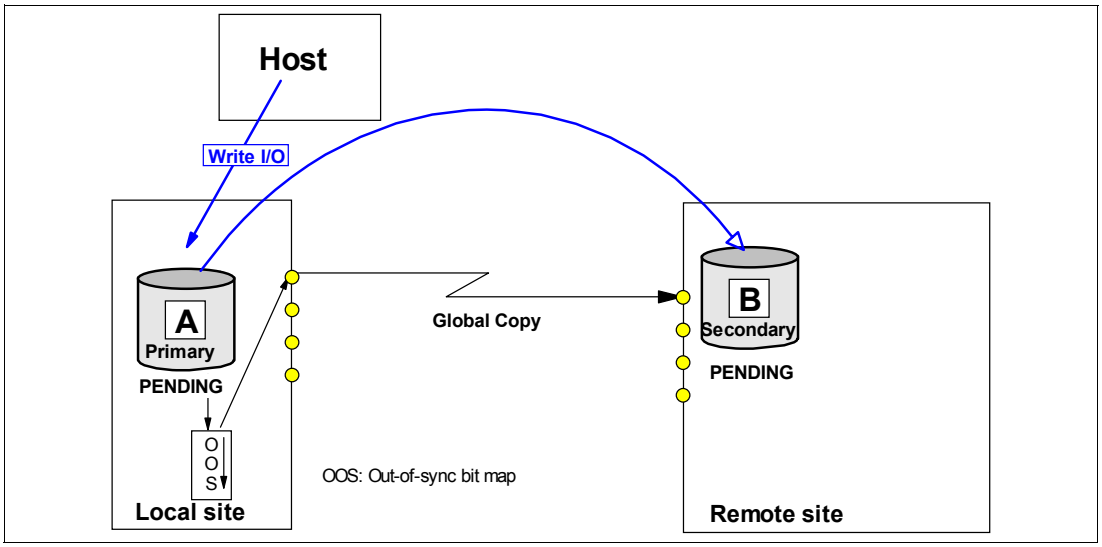

Figure 22-11 Establish Global Copy volume pair

Next, we create a Global Copy relationship between the local, or primary, volume and the remote, or secondary, volume; see Figure 22-11. This step changes the secondary volume state from *simplex* to *copy pending*. This copy pending state applies to both volumes, *primary pending* and *secondary pending*. At the same time data starts to be copied from the primary volume to the secondary volume. After a first complete pass through the entire A volume, Global Copy will constantly scan through the out-of-sync bit map. This bitmap indicates changed data as it arrives from the applications to the primary disk subsystem—Global Copy replicates the data from the A volume to the B volume based on this out-of-sync bit map.

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In the following paragraphs we refer to the primary volume as the A volume and to the secondary volume as the B volume for simplicity.

Global Copy does not immediately copy the data as it arrives to the A volume. Instead, this is an asynchronous process. As soon as a track is changed by an application write I/O, it is reflected in the out-of-sync bitmap as with all the other changed tracks. There can be several concurrent replication processes that work through this bitmap, thus maximizing the utilization of the high bandwidth Fibre Channel links.

This replication process keeps running until the Global Copy volume pair A-B is explicitly or implicitly suspended or terminated. Note that a Global Mirror session command, for example, to pause or to terminate a Global Mirror session, does not affect the Global Copy operation between both volumes.

At this point data consistency does not yet exist at the remote site.

22.3.4 Introduce FlashCopy

FlashCopy is an integral part of the Global Mirror solution, and now it follows as the next step in the course of establishing a Global Mirror session; see Figure 22-12.

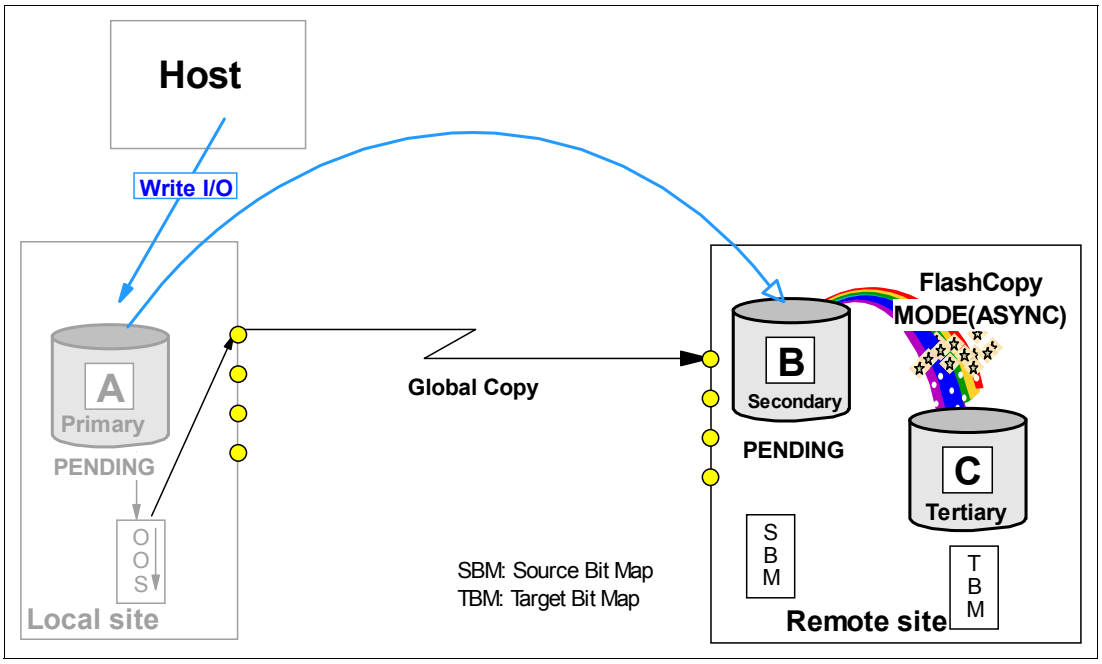

Figure 22-12 Introducing FlashCopy in the Global MIrror solution

The focus is now on the remote site. Figure 22-12 shows a FlashCopy relationship with a Global Copy secondary volume as the FlashCopy source volume. Volume B is now both at the same time, a Global Copy secondary volume and a FlashCopy source volume. In the same disk subsystem is the corresponding FlashCopy target volume.

Note that this FlashCopy relationship has certain attributes that are typical and required when creating a Global Mirror session. These attributes are:

- **Inhibit target write:** Protect the FlashCopy target volume from being modified by anyone other than Global Mirror related actions.

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- **Start change recording:** Apply changes only from the source volume to the target volume which occurred to the source volume in between FlashCopy establish operations —except for the first time when FlashCopy is initially established.
- **Persist:** Keep the FlashCopy relationship until explicitly or implicitly terminated. This parameter is automatic due to the *nocopy* property.
- **Nocopy:** Do not start background copy from source to target, but keep the set of FlashCopy bitmaps required for tracking the source and target volumes. These bitmaps are established at the first time when a FlashCopy relationship is created with the nocopy attribute. Before a track in the source volume B is modified, between Consistency Group creations, the track is copied to the target volume C to preserve the previous point-in-time copy. This includes updates to the corresponding bitmaps to reflect the new location of the track that belongs to the point-in-time copy. Note that each Global Copy write to its secondary volume within the window of two adjacent Consistency Groups may cause FlashCopy I/O operations.

Some interfaces to trigger this particular FlashCopy relationship combine these attributes into a single parameter such as MODE(ASYNC) with the TSO command for z/OS.

22.3.5 Define Global Mirror session

Creating a Global Mirror session does not involve any volume within the local nor the remote sites. Our focus is back again onto the local site; see Figure 22-13.

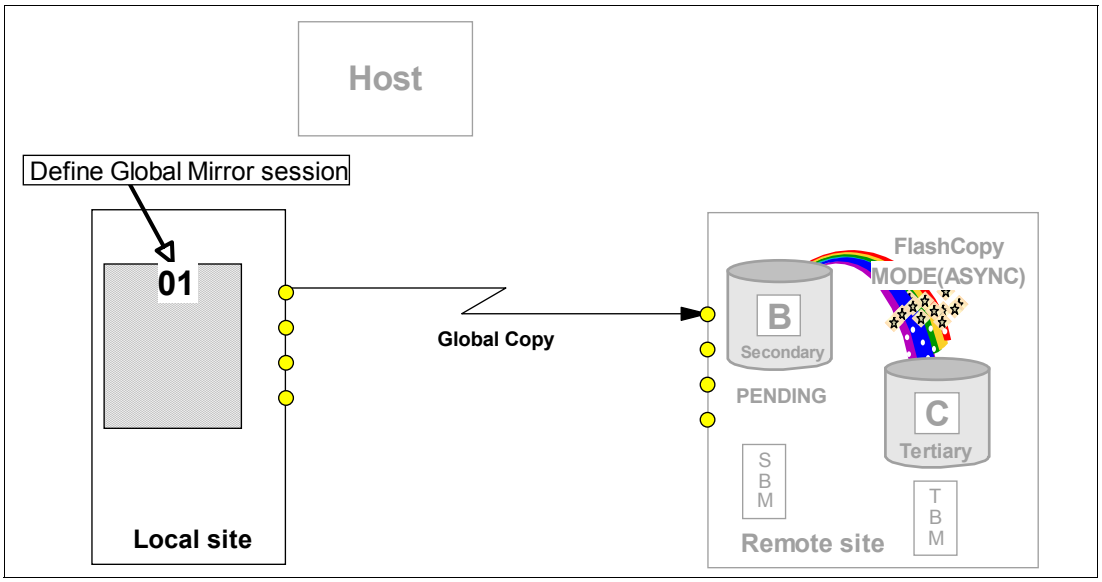

Figure 22-13 Define Global Mirror session

Defining a Global Mirror session, creates a kind of token, which is a number between 1 and 255. This number represents the Global Mirror session.

This session number is defined at the LSS level. Each LSS that has volumes which will be part of the session needs a corresponding define session command. Currently only a single session is allowed per storage server. The architecture allows for more than one session and will be exploited in the future.

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22.3.6 Populate Global Mirror session with volumes

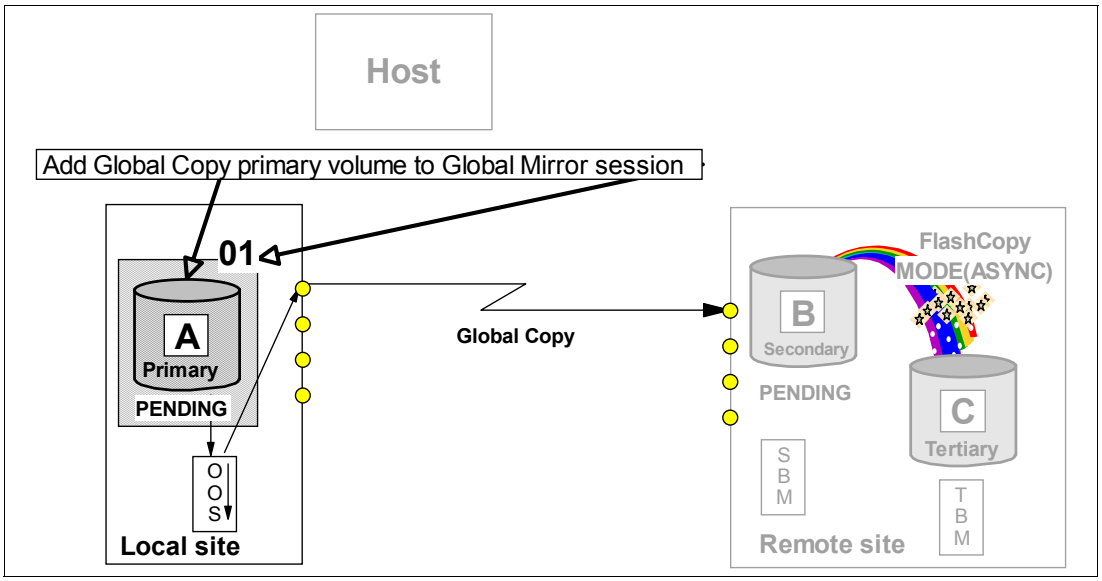

Figure 22-14 Add Global Copy primary volume to Global Mirror session

The next step is the definition of volumes in the Global Mirror session. The focus is still on the local site; see Figure 22-14. Note that only Global Copy primary volumes are meaningful candidates to become a member of a Global Mirror session.

This process adds primary volumes to a list of volumes in the Global Mirror session. But at this stage it does still not perform consistency group formation.

Note that Global Copy is replicating, on the Global Copy secondary volumes, the application updates that arrive to the Global Copy primary volumes. Initially the Global Copy primary volumes are placed in a *join pending* status. Once a Consistency Group is formed, the Global Copy primary volume will then be added to the session and will be placed in an *in session* status.

Nothing happens to the C volume after its initial establishment in a Global Mirror session.

22.3.7 Start Global Mirror session

This is the last step and it starts the Global Mirror session. Upon this, Global Mirror starts to form Consistency Groups at the remote site. As Figure 22-15 on page 260 indicates, the focus here is on the local site, with the start command issued to an LSS in the primary storage disk subsystem. With this start command you set the Master storage disk subsystem and the Master LSS. From now on, session related commands have to go through this Master LSS.

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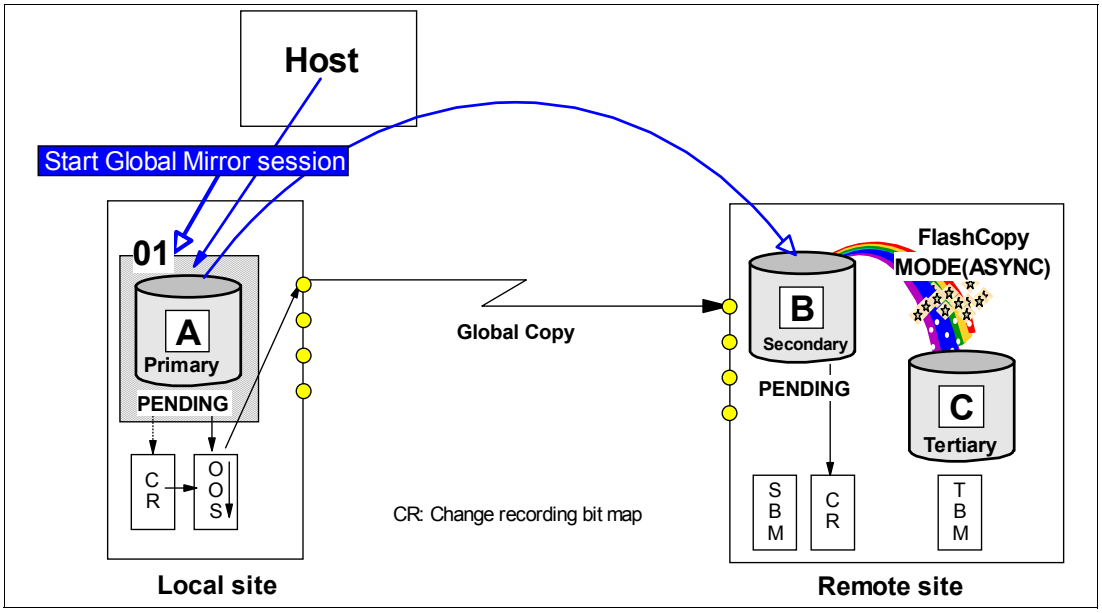

Figure 22-15 Start Global Mirror

This start command triggers events that involve all the volumes within the session. This includes a very fast bitmap management at the local storage disk subsystem, issuing inband FlashCopy commands from the local site to the remote site, and verifying that the corresponding FlashCopy operations successfully finished. This all happens at the microcode level of the related storage disk subsystems that are part of the session, fully transparently and in an autonomic fashion from the users perspective.

All C volumes that belong to the Global Mirror session comprise the Consistency Group. Now let´s see some more details about the Consistency Group creation at the remote site.

22.4 Consistency Groups

To achieve the goal of creating a set of volumes at a remote site that contains consistent data, asynchronous data replication alone is not enough—it must be complemented with either a kind of journal or a tertiary copy of the secondary volume. With Global Mirror this third copy is naturally created through the use of FlashCopy.

The microcode automatically triggers a sequence of autonomic events to create a set of consistent data volumes at the remote site. We call this set of consistent data volumes a Consistency Group. The following sections describe the sequence of events that create a Consistency Group.

22.4.1 Consistency Group formation

The creation of a Consistency Group requires three steps that are internally processed and controlled by the microcode. Outside of the Licensed Internal Code (LIC), these steps are fully transparent and do not require any other external code invocation or user action.

The numbers in Figure 22-16 on page 261 illustrate the sequence of the events involved in the creation of a Consistency Group. This illustration provides only a high level view that is sufficient to understand how this process works.

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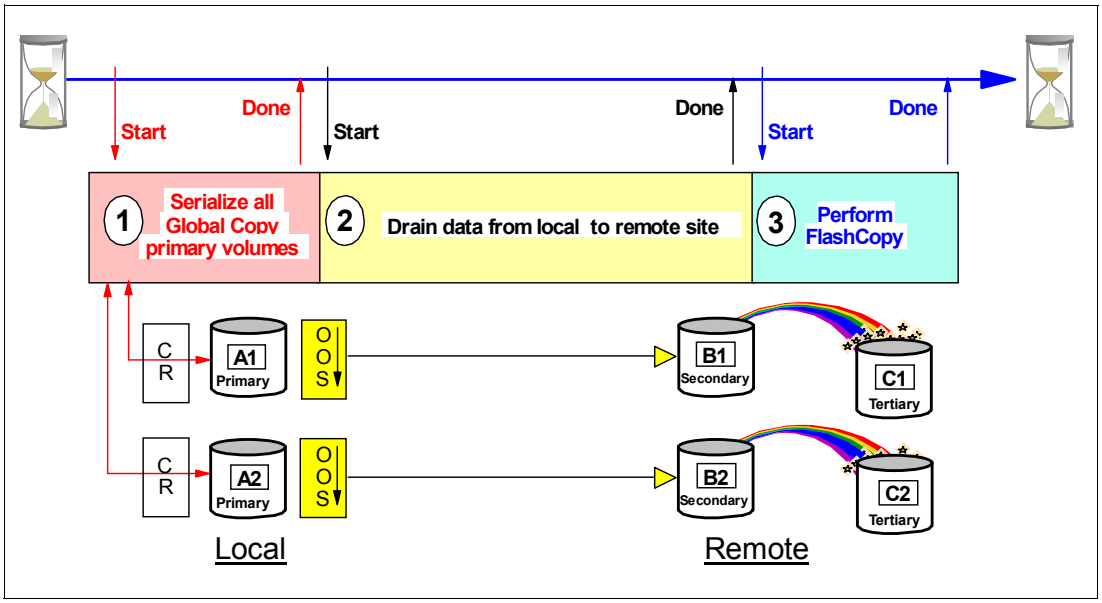

Figure 22-16 Formation of consistent set of volumes at the secondary site

Note that before step 1 and after step 3, Global Copy constantly scans through the out-of-sync bitmaps and replicates data from A volumes to B volumes as described in “Create Global Copy relationship between local and remote volume” on page 256.

When the creation of Consistency Group is triggered, the following steps occur in a serial fashion:

1. Serialize all Global Copy primary volumes. This imposes a brief hold on all incoming write I/Os to all involved Global Copy primary volumes. Once all primary volumes are serialized, the pause on the incoming write I/O is released and all further write I/Os are now noted in the change recording bitmap. They are not replicated until step 3 is done, but application write I/Os can immediately continue.
2. Drain includes the process to replicate all remaining data that is indicated in the out-of-sync bitmap and still not replicated. Once all out-of-sync bitmaps are *empty*—note that “empty” here does not mean in a literal sense—step 3 is triggered by the microcode from the primary site.
3. Now the B volumes contain all data as a quasi point-in-time copy, and are consistent due to the serialization process in step 1 and the completed replication or drain process in step 2. Step 3 is now a FlashCopy that is triggered by the primary system’s microcode as an inband FlashCopy command to volume B, as FlashCopy source, and volume C, as FlashCopy target volume. Note that this FlashCopy is a two phase process. First, the FlashCopy command to all involved FlashCopy pairs in the Global Mirror session. Then the Master collects the feedback and all incoming FlashCopy completion messages. When all FlashCopy operations are successfully completed, then the Master concludes that a new Consistency Group has been successfully created.

   FlashCopy applies here only to changed data since the last FlashCopy operation. This is because the *start change recording* property was set at the time when the FlashCopy relationship was established. The FlashCopy relationship does not end due to the *nocopy* property, which is also assigned at FlashCopy establish time; see “Introduce FlashCopy” on page 257. Note that the *nocopy* attribute results in that no physical background copy is done for any tracks. Only bitmaps are maintained and updated.

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Once step 3 is complete, a consistent set of volumes have been created at the secondary site. This set of volumes, the C volumes, represents the Consistency Group.

At this very moment also, the B volumes and the C volumes are, but only for this brief moment, equal in their content. Immediately after the FlashCopy process is logically complete, the primary systems's microcode is notified to continue with the Global Copy process. In order to replicate the changes to the A volumes that occurred during the step 1 to step 3 window, the change recording bitmap is mapped against the empty out-of-sync bitmap, and from now on, all arriving write I/Os will end up again in the out-of-sync bitmap. From now on the conventional Global Copy process, as outlined in"Create Global Copy relationship between local and remote volume" on page 256, continues until the next Consistency Group creation process is started.

22.4.2 Consistency Group parameters

In the previous section we described the sequence of steps followed once a Consistency Group create event is triggered. In the first step, the *serialization* step, when the Consistency Group spans over more than one primary disk subsystem, Global Mirror not only serializes all related Global Mirror primary volumes but also does the coordination with other storage disk subsystems.

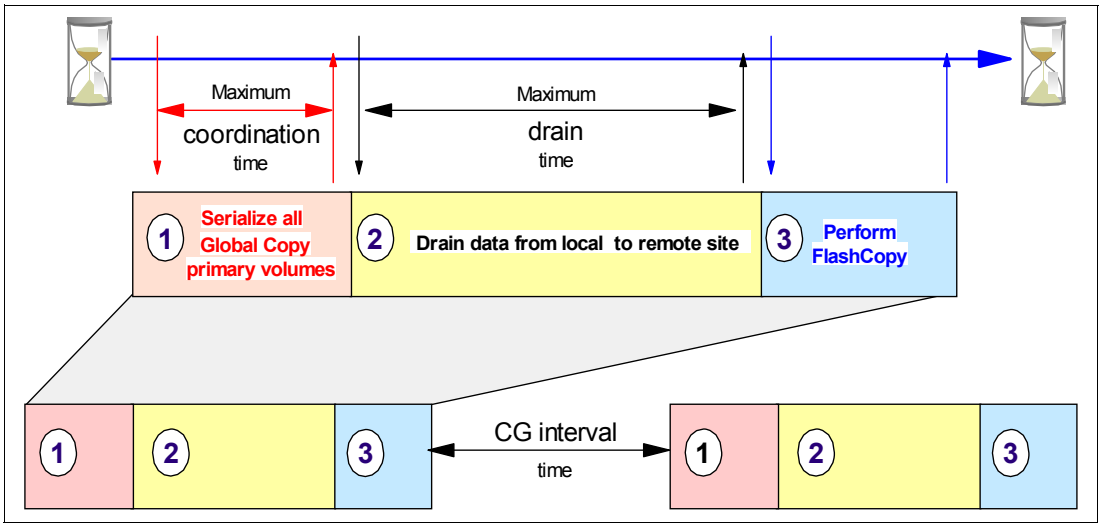

Figure 22-17 Consistency Group tuning parameters

There are three externalized parameters, and their default values can be overridden; see Figure 22-17:

- Maximum coordination time: dictates, for the Global Copy primary volumes that belong to this Consistency Group, how long a host write I/O may be impacted due to coordination and serialization activities. This time is measured in milli-seconds (ms). The default is 50 ms.
- Maximum drain time: is the maximum time allowed for draining the out-of-sync bitmap once the process to form a Consistency Group is started and step 1 successfully completed. The maximum drain time is specified in units of seconds. The default is 30 seconds.

  If the maximum drain time is exceeded, Global Mirror will fail to form the Consistency Group and will evaluate the current throughput of the environment. If this indicates that another drain failure is likely, Global Mirror will stay in Global Copy mode while regularly re-evaluating the situation to determine when to start to form the next Consistency Group.

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If this persists for a significant period of time, then eventually Global Mirror will force the formation of a new Consistency Group. In this way Global Mirror ensures that during periods when the bandwidth is insufficient, production performance is protected and data is transmitted to the secondary site in the most efficient manner possible. When the peak activity has passed, consistency group formation will resume in a timely fashion.

- Consistency Group interval time: once a Consistency Group has been created, the CG interval time determines how long to wait before starting with the formation of the next Consistency Group. This is specified in seconds, and the default is zero (0) seconds. Zero seconds means that Consistency Group formation happens constantly. As soon as a Consistency Group is successfully created, the process to create a new Consistency Group starts again immediately.

There is no external parameter to limit the time for the FlashCopy operation. This is due to its very fast bitmap manipulation process.

Global Mirror utilizes a distributed approach as well as a two-phase commit technique for activities between the Master and its Subordinate LSSs. The communication between the local and the remote site is organized through the Subordinate LSS. The Subordinates function here partly as a transient component for the Global Mirror activities, which are all triggered and coordinated by the Master. This distributed concept allows always to provide a set of data consistent volumes at the remote site independent of the number of involved storage disk subsystems at the primary or at the secondary site.

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Part 6

Global Mirror

This part of the book describes IBM System Storage Global Mirror for DS6000 when used in a System z environment. We discuss the characteristics of Global Mirror and describe the options for its setup. We also show which management interfaces can be used, as well as the important aspects to be considered when establishing a Global Mirror environment. This part ends with examples of Global Mirror management and setup.

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23

Global Mirror options and configuration

In this chapter we provide a detailed description of Global Mirror options, including how to create a Global Mirror environment and how to remove it. We discuss how to change Global Mirror tuning parameters and how to modify an active Global Mirror session. We also discuss a scenario where a sites switch is performed due to a primary site failure.

The information discussed in this chapter can be complemented with the following IBM publications:

- *z/OS DFSMS Advanced Copy Services*, SC35-0428
- *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922
- *Device Support Facility User's Guide and Reference*, SC35-0033

Global Mirror is intended for long distance data replication. For this, it relies on the network infrastructure and components used between the remote sites. This chapter does not cover network related topics. For information on these topics, refer to *IBM TotalStorage Business Continuity Solutions Guide*, SG24-6547.

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23.1 Terminology used in Global Mirror environments

First, let us review and further define some of the terms and new elements we have presented so far, and that are of common use when working in a Global Mirror context.

Dependent writes

If the start of one write operation is dependent upon the completion of a previous write, the writes are dependent. Application examples for dependent writes are databases with their associated logging files. Also updates to catalogs, VTOCs as well as VSAM indexes and VSAM data components rely on dependent writes. For instance, the database logging file will be updated after a new entry has been successfully written to a table space.

Compliance at the remote site, with the chronological order of dependent writes to primary volumes, is the basis to provide consistent data at the secondary site through remote copy operations.

Dependent writes is discussed in detail in 13.3.1, “Data consistency and dependent writes” on page 136, in the Metro Mirror part.

Consistency

The consistency of data is ensured if the order of dependent writes to disks or disk groups is maintained. With Copy Services solutions the data consistency at the secondary site is important for the usability of the data. Consistent data, for instance, gives the ability to perform a data base restart rather than a data base recovery that could take hours or even days.

Data consistency across all secondary volumes spread across multiple storage disk subsystems is essential for logical data integrity.

Data currency

This term describes the difference of time since the last data was written at the primary site, versus the time the same data was written to the secondary site. It determines the amount of data you have to recover at the remote site after a disaster. This is also called *recovery point objective* or RPO. Only synchronous copy solutions such as Metro Mirror have a currency of zero or RPO = zero. All asynchronous copy solutions have a data currency greater than zero.

With Global Mirror a data currency of a few seconds can be achieved, while data consistency is always maintained by the Consistency Group process within Global Mirror.

For asynchronous replication, this means that the data is not replicated at the same time that the local I/O happens, but the data is replicated with a certain time lag. Examples of different nonsynchronous or asynchronous replication methods are:

- Global Copy - a non-synchronous method that does not guarantee consistent data at the remote site.
- z/OS Global Mirror (formerly XRC) - an asynchronous replication method that guarantees consistent data at the remote site.
- Global Mirror - also an asynchronous replication method that provides consistent data at the remote site.

Session

A Global Mirror session is a collection of volumes that are managed together when creating consistent copies of data volumes. This set of volumes can reside in one or more LSSs and one or more storage disk subsystems at the primary site. Open systems volumes and z/OS volumes can both be members of the same session.

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When you start or resume a session, Consistency Groups are created, and the Master storage disk subsystem controls the session by communicating with the Subordinate storage disk subsystems.

There is also a session concept at the LSS level. But all LSS sessions are combined and grouped together within a Global Mirror session.

Master

The Master is a function inside a primary storage disk subsystem that communicates with Subordinates in other storage disk subsystems, and controls the creation of Consistency Groups while managing the Global Mirror session. The Master is defined when the start command for a session is issued to any LSS in a primary storage disk subsystem. This determines who becomes the Master storage disk subsystem.

The Master needs communication paths over Fibre Channel links to any one of the LSSs in each Subordinate disk storage server.

Subordinate

The Subordinate is a function inside a primary storage disk subsystem that communicates with the Master and is controlled by the Master. At least one of the LSSs of each Subordinate primary storage disk subsystems needs Fibre Channel communication paths to the Master. This enables the communication between the Master and the Subordinate, and is required to create Consistency Groups of volumes that spread over more than one storage disk subsystem.

If all the volumes of a Global Mirror session reside in one primary storage disk subsystem, no Subordinate is required, because the Master can communicate to all LSSs inside the primary storage disk subsystem.

Consistency Group

This is a group of volumes in one or more secondary storage disk subsystems whose data must be kept consistent at the remote site.

Local Site

This is the site that contains the production servers. This and other publications use this term interchangeably with the terms primary, production, or source site.

Remote Site

This is the site that contains the backup servers of a disaster recovery solution. This and other publications use this term interchangeably with the terms secondary, backup, standby, or target site.

23.2 Create a Global Mirror environment

The following section recommends a certain sequence of steps to establish a Global Mirror environment. This is independent of the interface used to create a Global Mirror environment. Note that for illustration purposes, parameters and keywords are used in this section that apply to TSO commands or to the ANTRQST macro interface. ICKDSF does use different keywords that are described in 24.5, “Global Mirror management using ICKDSF” on page 313.

We explain a basic Global Mirror setup, illustrated in Figure 23-1 on page 270.

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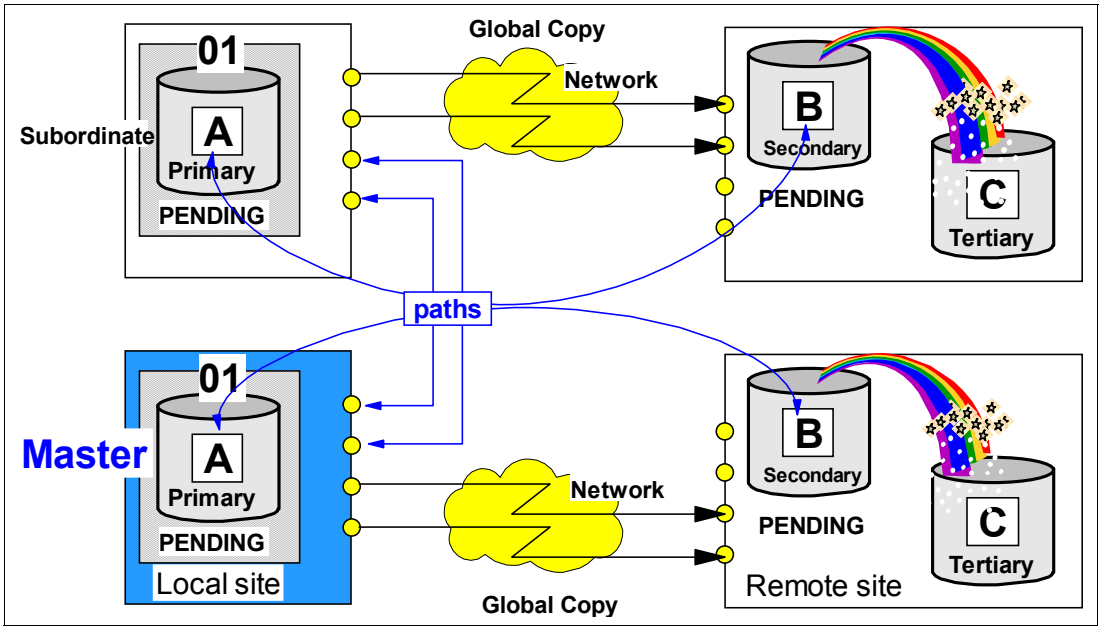

Figure 23-1 Global Mirror basic configuration with Master and Subordinate disk subsystems

The order of commands to create a Global Mirror environment is not completely fixed and allows for some variation. In order to be consistent with other sources and to not confuse the user with a different sequence of commands, we recommend a meaningful order and suggest the following steps to create a Global Mirror environment:

1. Establish the paths between the local site and the remote site. In Figure 23-1, these are the logical communication paths between corresponding LSSs at the primary site and the remote site, defined over Fibre Channel physical links that are configured over the network. Global Copy primary LSSs are represented by the A volumes, and their corresponding Global Copy secondary LSSs by the B volumes.

   You may also establish logical communication paths here between the Master and any Subordinate storage disk subsystem that will be part of the Global Mirror session. Note that these paths are defined between primary storage disk subsystems at the local site. With only a single primary storage disk subsystem, you do not need to define paths to connect internal LSSs within the primary storage disk subsystem. The communication between the Master and the Subordinates within a single primary storage disk subsystem is transparent and internally performed.

2. Once the communication paths are defined, start the Global Copy pairs that will be part of a Global Mirror session. Global Copy has to be established with the parameters MODE(COPY) and OPTION(XD) when you use CESTPAIR TSO commands. When you use ICKDSF use PPRCOPY ESTPAIR, which also has the parameters MODE(COPY) and OPTION(XD). We recommend that you wait until the first initial copy is complete before you continue to the next step. This avoids unnecessary FlashCopy background I/Os in the following step.

3. The next step is to establish FlashCopy relationships between the B and C volumes. The TSO FCESTABL command has a parameter, MODE(ASYNC), which combines and implies the particular FlashCopy attributes that are required for this FlashCopy relationship (see 22.3.4, “Introduce FlashCopy” on page 257). ICKDSF explicitly requires the keywords CHRCD(YES) NOTGTWT(YES) and MODE(NOCOPY) in the corresponding FC ESTABLISH commands.

4. With external Subordinates, that is, with more than one involved disk subsystem at the local site, you need paths between the Master LSS and any potential Subordinate storage

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disk subsystem at the local site. If you did not establish these paths in the very first step, then this is the time to create these paths before you continue with the next step.

5. Define a token that identifies the Global Mirror session. This is a session ID with a number between 1 and 255. Define this session number to the Master storage disk subsystem and also to all potentially involved primary LSSs that are going to be part of this Global Mirror session and will contain Global Copy primary volumes that will belong to the Global Mirror session. All primary LSSs include all LSSs in potential Subordinate storage disk subsystems that are going to be part of the Global Mirror session.
6. The next step populates the session with the Global Copy primary volumes. You should put these Global Copy primary volumes into the session after they complete their first pass for initial copy.
7. Start the session. This command actually defines the Master LSS. All further session commands have to go through this LSS. You may specify with the start command the Global Mirror tuning parameters such as maximum drain time, maximum coordination time, and Consistency Group interval time.

You go through this recommended sequence independent of the interface used.

23.3 Modify a Global Mirror session

Once a session is active and running, you may alter the Global Mirror environment to add or remove volumes. You may also add storage disk subsystems to a Global Mirror session or you may change the interval between the formation of Consistency Groups.

23.3.1 Add or remove volumes to a Global Mirror session

Volumes can be added to the session at any time after the session number is defined to the LSS where the volumes reside. Once the session is started, volumes can be added to the session or can be removed from the session also at any time.

Note: You only add Global Copy primary volumes to a Global Mirror session.

Volumes may be added to a session in any state, for example, *simplex* or *pending*. Volumes that have not completed their initial copy phase stay in a *join pending* state until the first initial copy is complete. If a volume in a session is *suspended*, it will cause Consistency Group formation to fail.

We recommend that you add only Global Copy primary volumes that have completed their initial copy or first pass, although the microcode itself will stop volumes from joining the Global Mirror session until the first pass is complete. Also, we recommend that you wait until the first initial copy is complete before you establish the FlashCopy relationship between the B and the C volumes.

Note: You cannot add a Metro Mirror primary volume to a Global Mirror session. Global Mirror supports only Global Copy pairs. When Global Mirror detects a volume which, for example, is converted from Global Copy to Metro Mirror, the following formation of a Consistency Group will fail.

When you add a rather large number of volumes at once to an existing Global Mirror session, then the available resources for Global Copy within the affected ranks may be utilized by the initial copy pass. To minimize the impact to the production servers when adding many new

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volumes, you may consider adding the new volumes to an existing Global Mirror session in stages.

Suspending a Global Copy pair that belongs to an active Global Mirror session will impact the formation of Consistency Groups. When you intend to remove Global Copy volumes from an active Global Mirror session, follow these steps:

1. Remove the desired volumes from the Global Mirror session; Example 23-2 on page 274 shows how to remove Global Copy volumes from a Global Mirror session, using TSO commands.
2. Withdraw the FlashCopy relationship between the B and C volumes.
3. Terminate the Global Copy pair to bring volume A and volume B into simplex mode.

Note: When you remove A volumes without pausing Global Mirror, you might see an error condition saying that the Consistency Group formation failed. However, this does not mean you have lost a consistent copy at the remote site because Global Mirror does not take the FlashCopy (B to C) for the failed Consistency Group data. This message indicates that just one Consistency Group formation has failed, and Global Mirror will retry the sequence.

23.3.2 Add or remove storage disk subsystems or LSSs

When you plan to add a new Subordinate storage disk subsystem to an active session, you have to stop the session first. Then add the new Subordinate storage disk subsystem and start the session again (with the updated RSESSION command, when you use TSO commands). The session start command will then contain the new Subordinate storage disk subsystem. This is valid also for any other interface used to manage a Global Mirror environment. The same procedure applies when you remove a storage disk subsystem from a Global Mirror session, which can be a Subordinate only—in other words, you cannot remove the Master storage disk subsystem.

When you add a new LSS to an active session and this LSS belongs to a storage disk subsystem that already has another LSS that belongs to this Global Mirror session, you may add the new LSS to the session without stopping and starting the session again. This is true for either the Master or for a Subordinate storage disk subsystem.

23.3.3 Modify Global Mirror session parameters

The parameters that are used for tuning a Global Mirror session may be modified by pausing the session and then resuming the session with the new values. The parameters that you may modify are:

- Consistency Group interval time
- Maximum coordination interval time
- Maximum Consistency drain time

When you issue a start command after a pause command, as opposed to a resume, any value for the Consistency Group interval time, maximum coordination interval time, or maximum Consistency Group drain time in the start command is ignored. If these parameters have to be altered, you have to give a resume command to the paused session with the parameters specified. If you resume a paused session without specifying these parameters, they will be set to their default values; see 22.4.2, “Consistency Group parameters” on page 262.

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Important: When setting new values for the tuning parameters, be sure to check for errors in Consistency Group formation and in draining the out-of-sync bitmaps. A few errors are not significant and do not jeopardize the consistency of your Global Mirror. However, if failures repeatedly occur, such as, no more consistency groups are formed, or the percentage of successful Consistency Groups is unacceptable, or the frequency of Consistency Groups is not meeting your requirements (Recovery Point Objective-RPO), then the new values set for the tuning parameters need to be revised and changed.

23.3.4 Global Mirror environment topology changes

The topology of a Global Mirror session, for example, the Master SSID, Subordinate SSIDs, and Subordinate serial numbers, cannot be altered through a pause and resume command sequence. When you resume the session after a pause and the Global Mirror topology is not the same as it was at the pause, the start of the session will fail.

If you need to change the topology of your Global Mirror session, you have to stop the session and start the session again with the new topology structure information in the start command.

Topology also refers to the list of storage disk subsystems that are subordinates. You define control paths between the Master and Subordinate LSSs—just one LSS per subordinate disk subsystem is sufficient. When you define the control paths, you identify the source LSS on the Master disk subsystem with its corresponding subsystem ID (SSID). The target LSS in the path definition command points to a corresponding subordinate disk subsystem, and is also identified by its corresponding SSID. These SSIDs go into the topology specification, which defines the communication paths between Master and Subordinate storage disk subsystems.

This topology is specified in the SBINFO parameter and is required for the following Global Mirror operations:

- Start a Global Mirror session.
- Stop a Global Mirror session.
- Pause a Global Mirror session.
- Resume a Global Mirror session.

In Example 23-1 the topology information is passed to Global Mirror in the context of establishing the paths between Master and Subordinate.

Example 23-1 Context between establish path and Global Mirror topology

```
CESTPATH   DEVN (X'6000')                          +
             PRIM (X'6000' 500507630EFFFC6F  X'00') +
             SEC  (X'6400' 500507630EFFFCA0  X'00') +
             LINK (X'00000000' X'01000100') CGROUP(NO)

  RSESSION   SNBR(01) VOLSER(AA601F)           +
             ACTION(START)                     +
             LSSTYPE(CKD) LSSNBR(00)           +
             MSSERIAL (AAGXA) MASTER(YES)      +
             SBINFO(6000,6400,AAVCA)
```

On the CESTPATH command, the sending Master SSID is 6000 and the receiving Subordinate SSID is 6400. These are the SSIDs as they are defined in the establish path command. Also in this command there is a link between the SSID and its corresponding LSS number, which in both cases is x'00'.

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The RSESSION command contains the topology information for the Subordinate and also the communication paths specification. SBINFO contains positional parameters in the following order:

- SSID of the sending Master LSS
- SSID of the receiving LSS in the Subordinate disk subsystem
- Serial number of the Subordinate disk subsystem

When the topology changes and needs to be reflected in an existing Global Mirror environment, you need to stop the session with the SBINFO specification, as it was at the previous start of the Global Mirror session. Then you adjust SBINFO so that it reflects the changed topology and then start the session again, now with the new SBINFO specifications. See also 23.3.2, “Add or remove storage disk subsystems or LSSs” on page 272.

23.3.5 Remove a FlashCopy relationship

When you withdraw a FlashCopy relationship within a Global Mirror session, the Consistency Group process is affected. If a withdraw is required, then first remove the Global Copy primary volume from the session. Example 23-2 shows a TSO command that removes a volume from LSS 0C and two volumes from LSS 0D.

Example 23-2 Remove volumes from Global Mirror session

```
RVOLUME    SNBR(01) VOLSER(XX2C00)          +
             ACTION(REMOVE)                   +
             LSSTYPE(CKD) LSSNBR(0C)          +
             ESSSERIAL(27131)                 +
             VOLLIST  (00)

  RVOLUME    SNBR(01) VOLSER(XX2D00)          +
             ACTION(REMOVE)                   +
             LSSTYPE(CKD) LSSNBR(0D)          +
             ESSSERIAL(27131)                 +
             VOLRANGE (00:01)
```

Once the volumes are removed from the session, you may explicitly terminate the corresponding FlashCopy relationship that was tied to this primary volume.

Example 23-3 Remove FlashCopy relationship

```
FCWITHDR  SDEVN(X'3C00')  TDEVN(X'3E00')


   FCWITHDR  DEVN(X'2C00') SOURCE(73081 00 0C)  +
                           TARGET(73081 00 0E)  +
                           REMOTE(YES) SSID(3C00)
```

Example 23-3 shows TSO FlashCopy commands that are used to terminate FlashCopy relationships. The first FlashCopy command assumes a host channel connectivity to the remote storage disk subsystem. In this case you can issue a simple FCWITHDR command with the source and target volumes addressed by their z/OS device numbers. When there is no host connectivity established to the remote storage disk subsystem, then you may use an inband FlashCopy command through the local Global Copy primary volume. The second FCWITHDR command propagates the FlashCopy command over the Global Mirror paths to the remote storage server. The SOURCE and TARGET parameters address the source and target volumes in the remote storage server. The SSID parameter addresses the LSS that contains the source volume. In both examples, consider that despite the removal of the

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volumes from the Global Mirror session, Global Copy keeps running and replicating newly arrived write I/Os over the paths to the remote storage disk subsystem.

The termination of FlashCopy relationships, may be needed when you want to change the FlashCopy targets within a Global Mirror configuration and choose, for example, another LSS for the FlashCopy targets. This may be needed because you want to replace the FlashCopy targets due to a skew in the load pattern in the remote storage disk subsystem. In this situation you may pause the session before such activity, and then resume the session again once the removal of the FlashCopy relationships is completed.

Note: A pause command will complete a Consistency Group formation in progress. A stop will immediately end the formation of Consistency Groups.

23.4 Remove a Global Mirror environment

To remove a Global Mirror environment and remove all traces of Global Mirror we recommend the following sequence of steps:

1. Terminate the Global Mirror session.
2. Remove all Global Copy primary volumes from the Global Mirror session.
3. Close the Global Mirror session.
4. Withdraw all FlashCopy relationships between the B and C volumes.
5. Terminate all Global Copy pairs.
6. Remove the paths between the local and remote sites.
7. Remove the paths between the Master LSS and all related Subordinate LSSs.

Chapter 26, “Global Mirror examples” on page 341 has examples that illustrate how to perform the listed steps.

23.5 Global Mirror with multiple storage disk subsystems

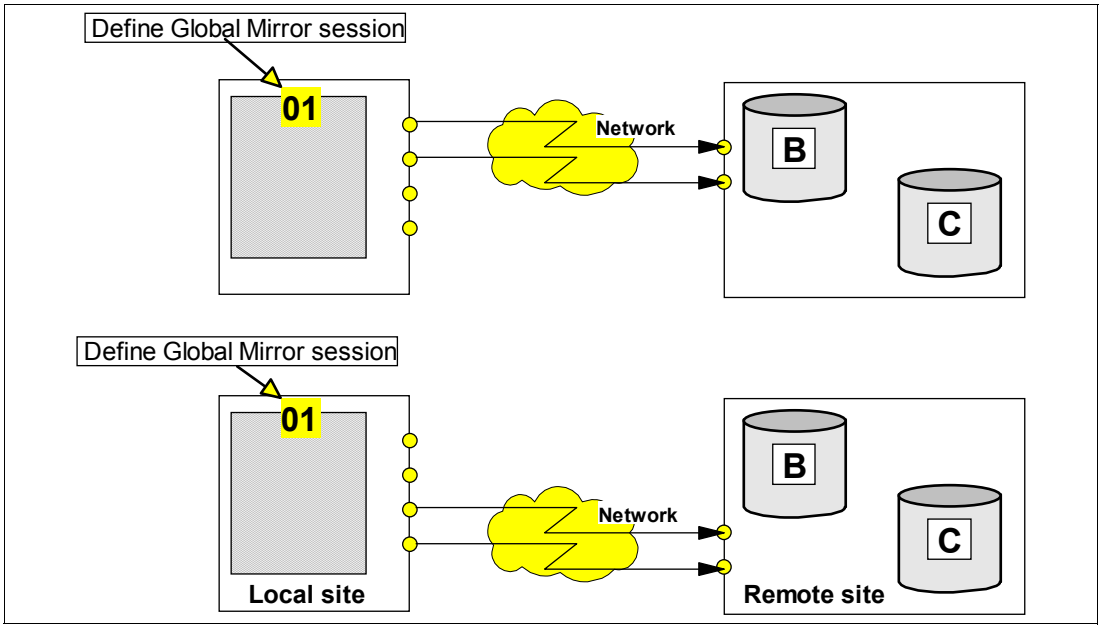

Figure 23-2 Define Global Mirror session to all potentially involved storage disk subsystems

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When you create a Global Mirror environment that spans multiple storage disk subsystems at the local site, and probably also at the remote site, then you need to establish communication paths between the involved local storage disk subsystems.

Figure 23-2 on page 275 shows a symmetrical configuration with a one-to-one mapping. You have to define the corresponding session, with its number, to all potentially involved LSSs at the local site. As illustrated in Figure 23-2, there is still no connection between the two local storage disk subsystems. Therefore, we have to define the corresponding Global Mirror paths; see Figure 23-3.

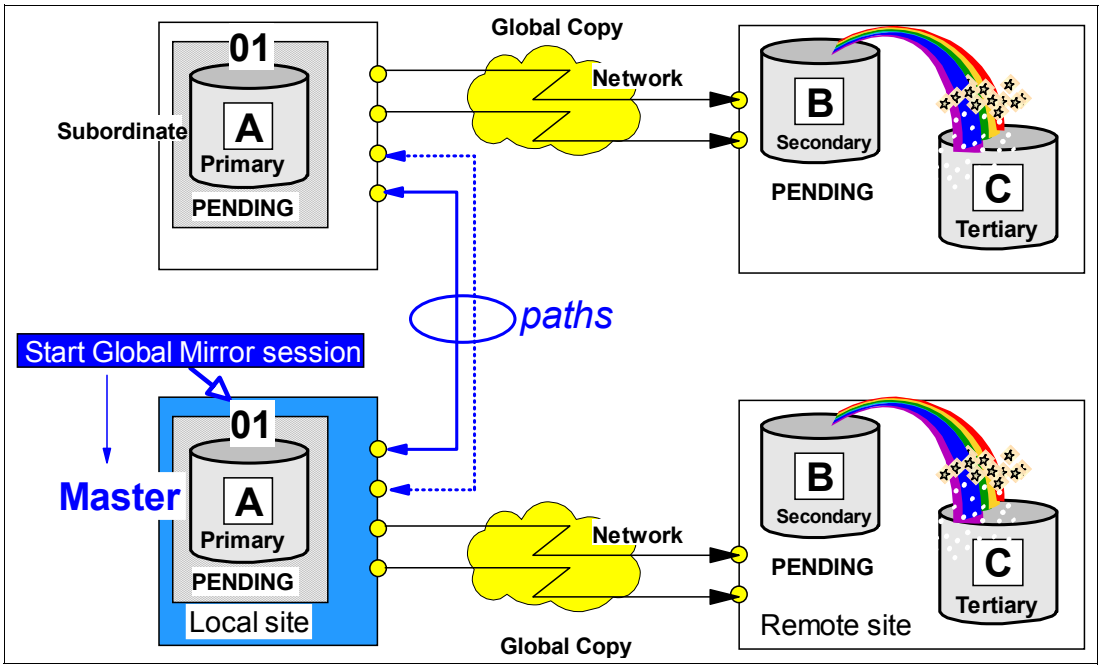

Figure 23-3 Decide for Master storage server and start a Global Mirror session

Through the start command, you decide which LSS becomes the Master LSS and consequently which local storage disk subsystem becomes the Master storage unit. This Master acts indeed like a server in a client/server environment.

The required communication between the Master storage disk subsystem and the Subordinate storage disk subsystems is inband, over the defined Global Mirror paths. This communication is highly optimized, and minimizes any potential application write I/O impact during the coordination phase to about a few milliseconds. For details see 22.4, “Consistency Groups” on page 260.

Note that this communication is performed over FCP links. At least one FCP link is required between the Master storage disk subsystem and the Subordinate storage disk subsystem. Figure 23-4 on page 277 uses dashed lines to show the Global Mirror paths that are defined over FCP links, between the Master storage disk subsystem and its associated Subordinate storage disk subsystems. These FCP ports are dedicated for Global Mirror communication between Master and Subordinates.

Also shown in Figure 23-4, is a shared port on the Master storage disk subsystem, and dedicated ports at the Subordinates. Not considering availability, from a communications and traffic viewpoint only, a link would be sufficient for the traffic between the Master and its Subordinates. For redundancy, we suggest configuring two links.

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Note that when you configure links over a SAN network, the same FCP ports of the storage disk subsystem may be used for the Global Mirror session communication, as well as for the Global Copy communication, and for host connectivity. However, for performance reasons, and to prevent host errors from disrupting your Global Mirror environment, it is often a good idea to use separate FCP ports.

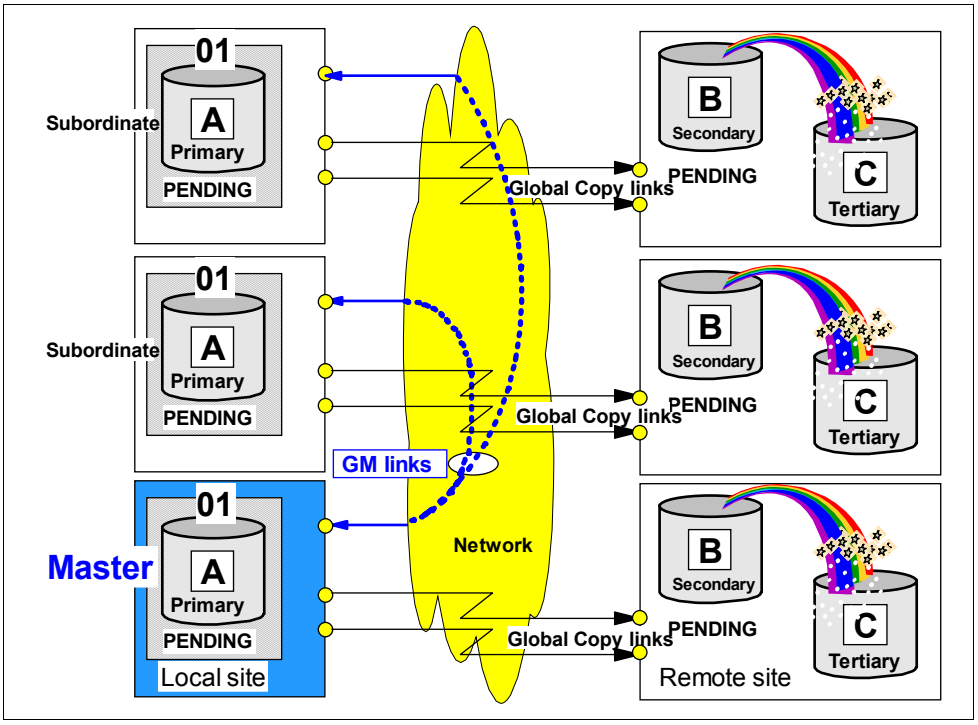

Figure 23-4 Global Mirror paths over FCP links between primary storage disk subsystems

The sample configuration in Figure 23-5 shows a mix of dedicated and shared FCP ports.

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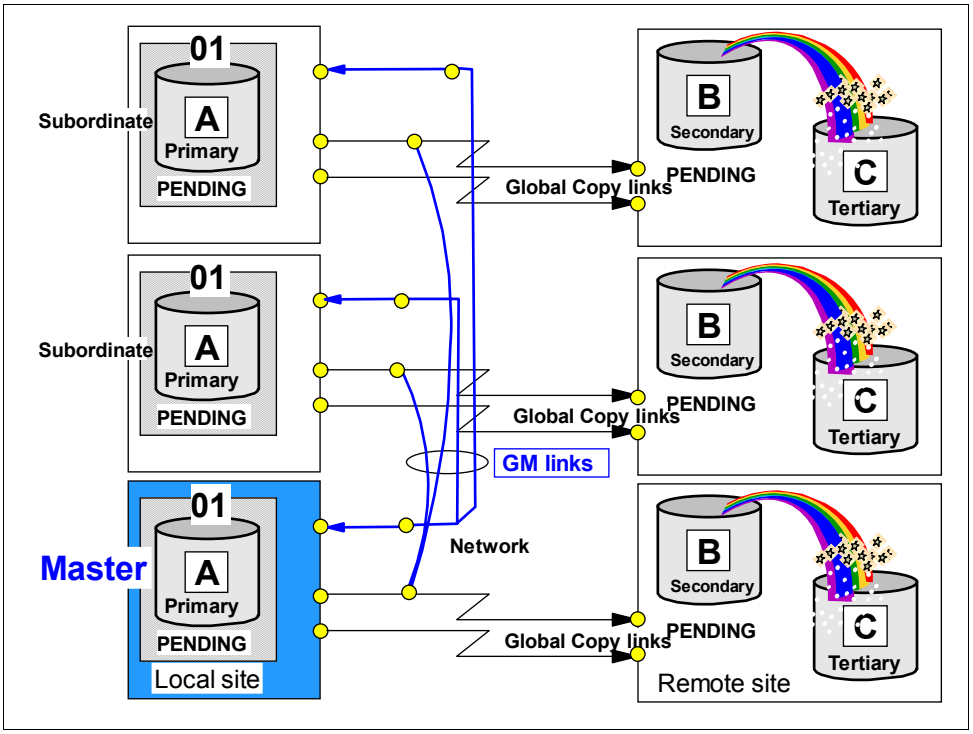

Figure 23-5 Dedicated and shared links

In Figure 23-5 an FCP port in the Master storage disk subsystem is used as Global Mirror link to the other two Subordinate storage disk subsystems, and is also used as Global Copy link to the secondary storage disk subsystem. Also, there are ports at the Subordinate storage disk subsystem that are used as Global Mirror session link as well as Global Copy link.

If possible, a better configuration is the one shown in Figure 23-6. Again, from a performance and throughput viewpoint, you would not need two Global Mirror links between the Master and its Subordinate storage disk subsystems. Still, dedicated ports for Global Mirror control communication between Master and Subordinate provides a maximum of responsiveness.

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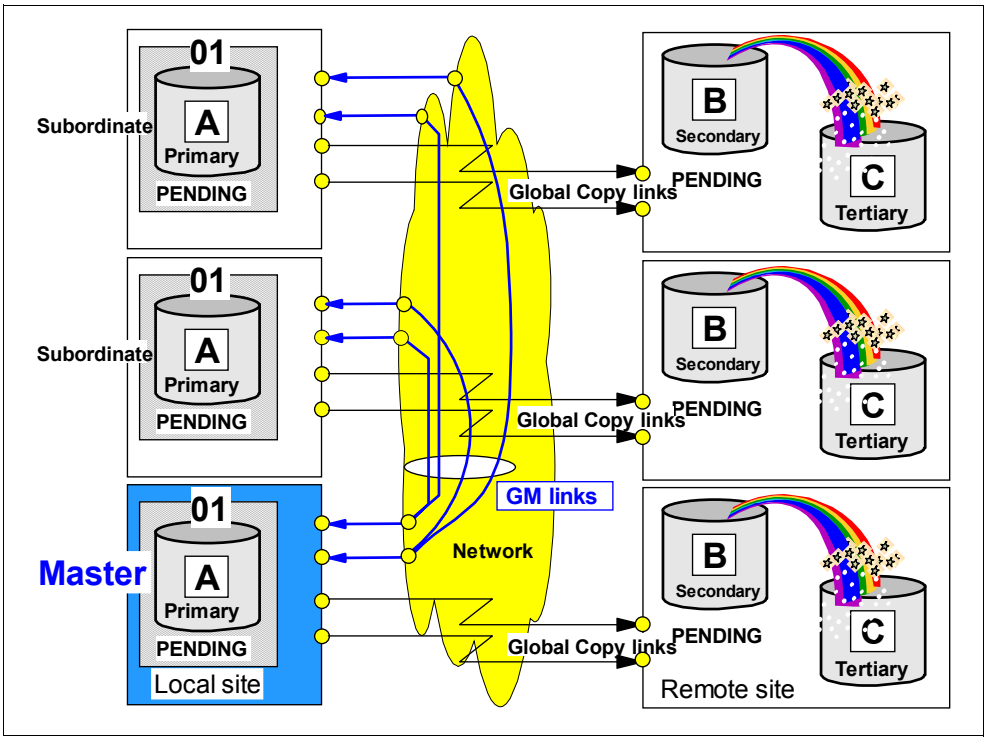

Figure 23-6 Dedicated Global Mirror links and dedicated Global Copy links

23.6 Connectivity between local and remote site

The choice of which interface to use for Global Mirror management may depend on how the 2-site configuration is designed. A multi-host configuration allows you to configure and manage the remote site using the host systems at the remote site. This alternative does not require the use of inband commands. Alternatively, in a single site host configuration you can access the remote site using the local host, when the distance does not exceed standard FICON distance.

23.6.1 Multi-site host connectivity

Figure 23-7 on page 280 shows a configuration with hosts connected to their local disk subsystems only. In this example there is no connection between the hosts of one site and the storage disk subsystems of the other site. This example shows a typical 2-site disaster recovery solution with the application host at the local site. The host at the remote site may be a stand-by host, or a system that hosts non-critical applications and may be expanded through CBU when a site switch from the local site to the remote site is required.

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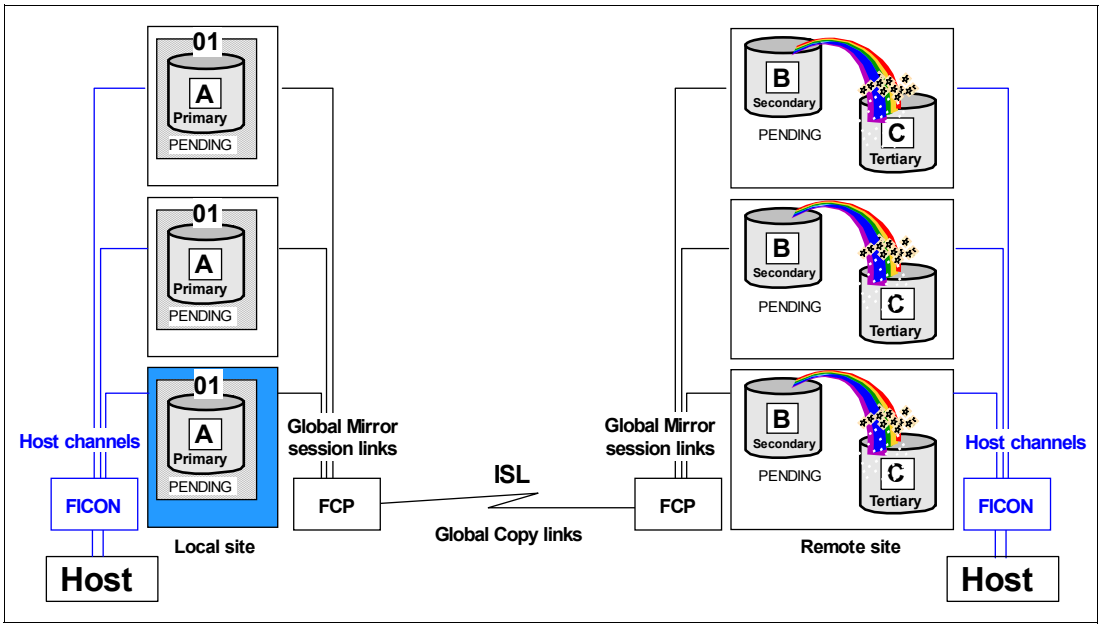

Figure 23-7 Host connectivity at both sites

In case of a failure at the local site the host at the remote site may recover from the Global Mirror configuration as discussed in 23.7, “Recovery scenario after primary site failure” on page 282. Note that the host at the remote site requires a disk environment that is independent from the Global Mirror environment.

All Global Mirror-related management commands may be executed at the respective site. The local host may execute all commands that address the primary volumes. The remote host may execute all the commands targeted to the secondary or tertiary volumes. From a management viewpoint this may not be the preferable approach to managing a Global Mirror environment.

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23.6.2 Single site host connectivity

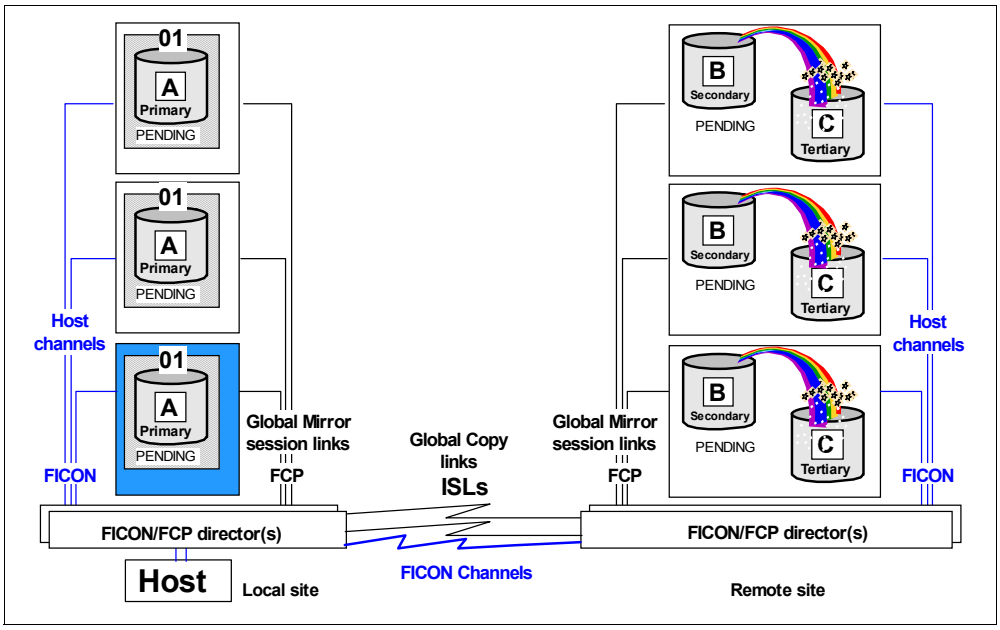

Figure 23-8 Single site host connectivity - with or without FICON connectivity between sites

Figure 23-8 shows a single host configuration example. This is again a 2-site disaster recovery solution, although there are no hosts on one of the sites, the recovery site. Recovery is provided at the storage disk subsystem level—data recovery.

Depending on how far apart the two sites are from each other, there are two basic approaches to managing this configuration:

1. The sites are at FICON distance.

   This allows you to connect the host to both sites and manage either site from the host via conventional Global Mirror inband commands. Such a configuration may use cascaded FICON directors to interconnect both sites using FICON channels. In case of a primary site failure, limited to storage disk subsystems, the failover may be managed from the local host. See 23.7, “Recovery scenario after primary site failure” on page 282.

   Note: This scenario is ideal for a synchronous solution, such as Metro Mirror. Metro Mirror provides zero data loss with almost no impact to host I/O at short distances. Additionally, Metro Mirror environments tend to be less complex than Global Mirror environments.

2. The two sites are not interconnected over FICON due to extended distances, or the required network technology for FICON is not available.

   Global Mirror management of the remote storage disk subsystems can be done through inband commands from the local site. This is limited to FlashCopy operations only. Besides the TSO and ICKDSF inband FlashCopy commands, you may consider using DS CLI commands.

   Recovery operations as described in 23.7, “Recovery scenario after primary site failure” on page 282 require host connectivity at the remote site when utilizing TSO or ICKDSF-based Global Mirror commands. To quickly recover the remote site you may consider using DS CLI commands, which do not require any host connectivity.

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Figure 23-8 shows more than a single FICON/FCP director at both sites, for availability reasons. Note that the Master and Subordinate paths are defined over a local SAN fabric, represented by the FICON/FCP directors.

23.7 Recovery scenario after primary site failure

This section covers the steps that you need to follow in a Global Mirror environment, when a primary site failure requires you to recover at the secondary site. This discussion does not cover the specifics concerning whether it is a single site host connectivity scenario or multi-site host connectivity scenario, as discussed in 23.6, “Connectivity between local and remote site” on page 279.

23.7.1 Normal Global Mirror operation

Figure 23-9 shows a simple configuration with Global Mirror active and running.

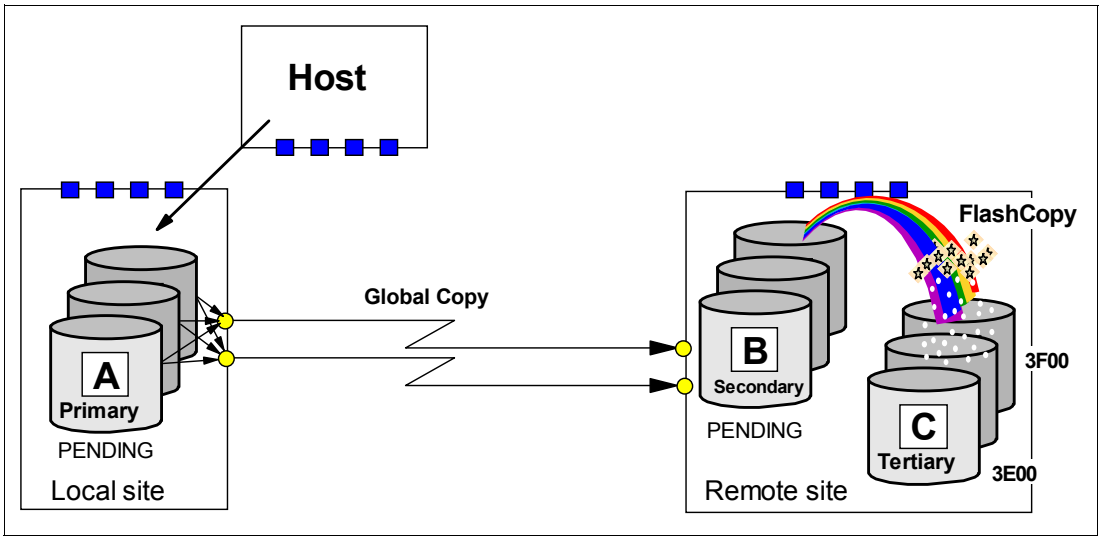

Figure 23-9 Normal Global Mirror operation

Host writes are replicated through Global Copy. Consistency Groups are created as tertiary copies. The B volumes are Global Copy secondary volumes, and they are also FlashCopy source volumes. The C volumes are the FlashCopy target volumes.

23.7.2 Primary site failure

A failure at the local site prevents all I/O to the local storage disk subsystems; see Figure 23-10. This may have some impact on the formation of Consistency Groups because the entire process is managed and controlled by the Master storage disk subsystem that is also the primary disk subsystem—and it just failed, and cannot communicate any longer with its partners at the remote site.

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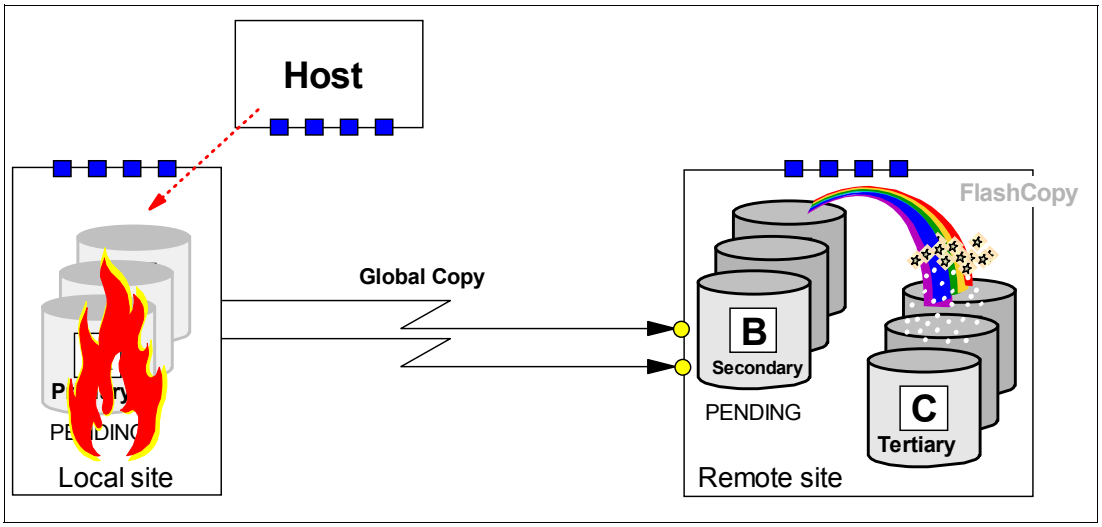

Figure 23-10 Primary site fails

The goal is to swap to the remote site and restart the applications. This requires, first, to make the set of consistent volumes at the remote site available for the application, before the application can be restarted at the remote site.

Then, once the local site is back and operational again, we have to return to the local site. Before returning to the local site, we have to apply, to the primary volumes, the changes that the application made to the secondary data while it was running at the remote site. After this, we should be doing a quick swap back to the local site and restart the application.

When the local storage disk subsystem fails, Global Mirror can no longer form Consistency Groups. Depending on the state of the local storage disk subsystem, you may be able to terminate the Global Mirror session. Usually this is not possible because the storage disk subsystem may not respond any more. Host application I/O may have failed and the application ended. This usually goes along with messages or SNMP alerts that indicate the problem. With automation in place, as for example Geographically Dispersed Parallel Sysplex™ (GDPS) or eRCMF, these alert messages trigger the initial recovery actions.

If the formation of a Consistency Group was in progress, then, most probably, not all FlashCopy relationships between the B and C volumes at the remote site will have reached the corresponding point-in-time. Some FlashCopy pairs may have completed the FlashCopy phase to form a new Consistency Group, and committed the changes already. Others may not have completed yet, and are in the middle of forming their consistent copy, and remain in a revertible state. And there is no Master any longer to control and coordinate what may still be going on. All of this forces a closer look at the volumes at the remote site before we can continue to work with them. There will be more discussion of this in the following sections. First, however, we just bring the B volumes into a usable state using the failover command.

23.7.3 Failover B volumes

Because the primary storage disk subsystem may no longer be usable, the recovery actions and processing now occur at the remote site, using a host connected to the remote disk subsystems. For this, you may use either TSO commands or ICKDSF.

When there is no host connected to the remote disk subsystem, you may still carry on the necessary management activities through the Web-based GUI interface or using the DS CLI

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commands. In our example, we assume that there is a host connection to the remote storage disk subsystem; see Figure 23-11.

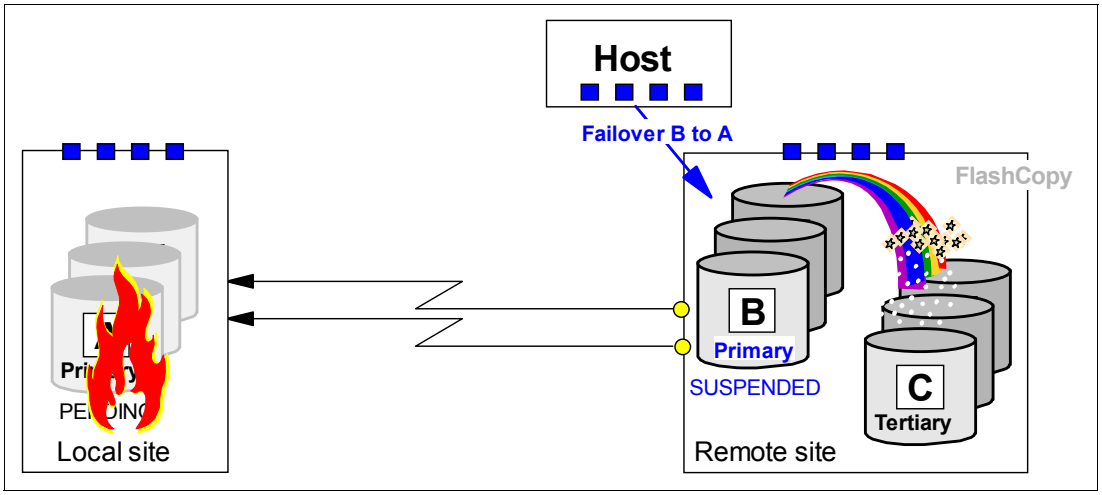

Figure 23-11 Failover from B to A

Doing a Failover (Copy Services Failover function) on the Global Copy secondary volumes will turn them into primary volumes, and suspend the volumes immediately. This sets the stage for change recording when application updates start changing the B volumes. Change recording in turn allows you to just resynchronize the changes later from the B to the A volumes, before returning to the local site to resume the application again at the local site. But at this stage the B volumes do not contain consistent data—they are still useless. We just changed their state from secondary copy pending to primary suspended. The A volumes state remains unchanged.

Example 23-4 shows the establish command that we give at the secondary site. The key with this command is the FAILOVER option. It is this option that invokes the Failover function of Copy Services. After this action, the B volume becomes the primary volume, and the A volume becomes the secondary, even though A may not be available and will remain as primary full duplex.

Example 23-4 ESTPAIR command with Failover action

```
//* ---------------------------- TSO --------- FAILOVER (3) ------ ***
//* ESTABLISH GLOBAL COPY PAIR(S) FAILOVER PRIM(B) -> SEC(A) ***
//*                                                                ***
//*   NOTE: ACTION IS NOT VALID WITH MODE(COPY)                    ***
//* ------------------------------------------------------------- ***
//EPAIRFO EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'3C00')                    +
           PRIM (X'3C00' 73081 X'00' X'0C')  +
           SEC  (X'2C00' 27131 X'00' X'0C')  +
           ACTION(FAILOVER)                  +
           ONLINSEC(NO)  MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)                CASCADE(NO)
```


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Note that this command just changes the state of the secondary volumes from *secondary pending* to *primary suspended*. This command does not communicate to the other storage disk subsystem at all, even though it is specified in the SEC parameter of the command. Once all the Failover commands are successfully executed, we can move on to the next step.

23.7.4 Check for valid Consistency Group state

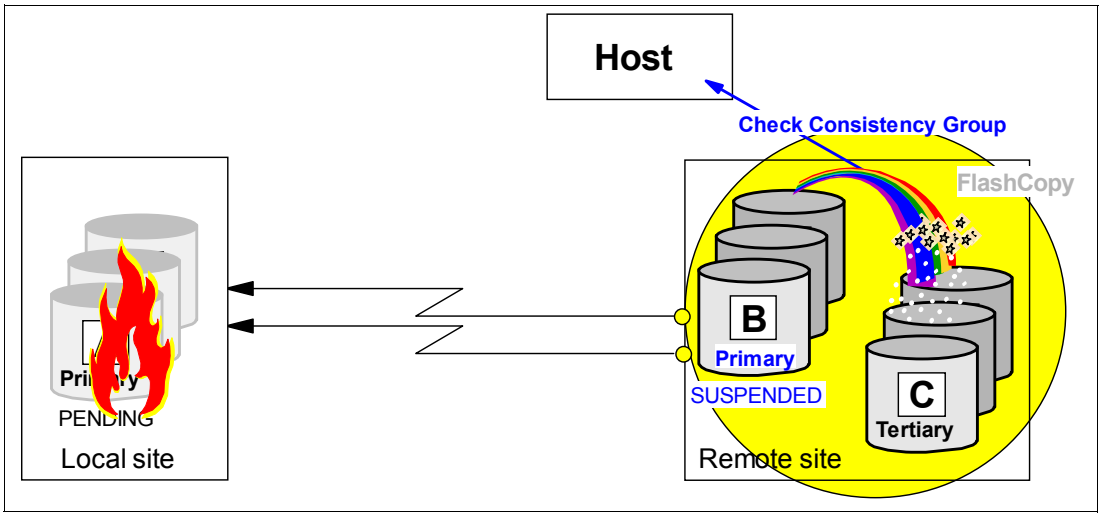

Figure 23-12 Check Consistency Group state

Now you have to investigate whether all FlashCopy relationships are in a consistent state; see Figure 23-12. This means you have to query all FlashCopy relationships between B and C, which are part of the Consistency Group, to determine the state of the FlashCopy relationship. Global Mirror might have been in the middle of forming a Consistency Group and FlashCopy may not have completed the creation of a complete set of consistent C volumes.

Each FlashCopy pair needs a FlashCopy query to identify its state. Example 23-5 shows FlashCopy query commands of four FlashCopy source volumes (B volumes).

Example 23-5 FlashCopy query of four FlashCopy relationships

```
TIME-09:36:44 AM. CPU-00:00:00 SERVICE-68 SESSION-00:00:00 JUNE 15,2005
READY
FCQUERY   DEVN (X'6400')
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
6400 0002  00  00 1750 0000000AAVCA      1  50099  N  S  N  N 42B03957
FCQUERY COMMAND COMPLETED FOR DEVICE 6400. COMPLETION CODE: 00

FCQUERY   DEVN (X'6401')
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
6401 0002  00  01 1750 0000000AAVCA      1  50099  N  S  N  N 42B03957
FCQUERY COMMAND COMPLETED FOR DEVICE 6401. COMPLETION CODE: 00

FCQUERY   DEVN (X'6402')
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
6402 0002  00  02 1750 0000000AAVCA      1  50099  N  S  N  N 42B03957
FCQUERY COMMAND COMPLETED FOR DEVICE 6402. COMPLETION CODE: 00

FCQUERY   DEVN (X'6403')
```


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```
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
6403 0002  00  03 1750 0000000AAVCA      1  50099  N  S  N  N 42B03957
FCQUERY COMMAND COMPLETED FOR DEVICE 6403. COMPLETION CODE: 00
```

Example 23-5 shows, for each single FlashCopy relationship, a column titled RV, which stands for *revertible*. An N indicates that this FlashCopy relationship is not revertible and all changes are committed. All volumes show the same information for RV. The other column that you have to check is the SEQNUM or FlashCopy sequence number. This number is also identical for all four volumes in Example 23-5, which is good information. This leads you to conclude that:

- All FlashCopy pairs are non-revertible.
- All FlashCopy sequence numbers are equal.

No further action is necessary and the set of C volumes is consistent and a good copy.

Figure 23-13 shows the consistency group creation process. The action required depends on the state of the consistency group creation process when the failure occurred.

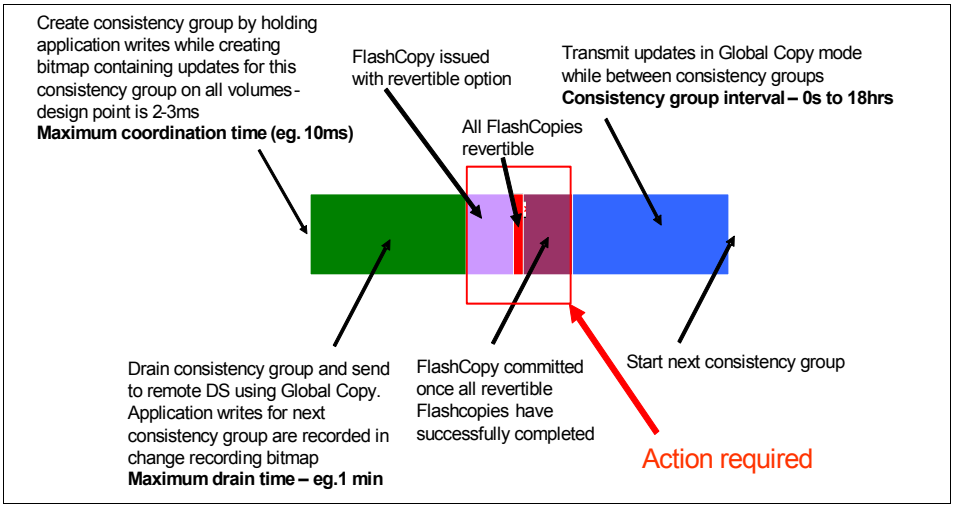
Create consistency group by holding application writes while creating bitmap containing updates for this consistency group on all volumes - design point is 2-3ms
Maximum coordination time (eg. 10ms)
FlashCopy issued with revertible option
Transmit updates in Global Copy mode while between consistency groups
Consistency group interval – 0s to 18hrs
All FlashCopies revertible
Drain consistency group and send to remote DS using Global Copy. Application writes for next consistency group are recorded in change recording bitmap
Maximum drain time – eg.1 min
FlashCopy committed once all revertible Flashcopies have successfully completed
Start next consistency group
Action required

Figure 23-13 FlashCopy consistency group creation process

Depending on when the failure occurs, there are some combinations of revertible states and FlashCopy sequence numbers that need different corrective actions. Use Table 23-1 as a guide. This is a decision table that is read in the following way: When column 2 *and* column 3 are true, then take the action in column 4. Column 5 contains additional comments. Do this for each of the four cases. The cases are described in chronological order, starting from the left.

Table 23-1 Consistency Group and FlashCopy validation decision table

	Are all FC relationships revertible?	Are all FC sequence numbers equal?	Action to take	Comments
Case 1	NO.	YES.	No action needed. All C volumes are consistent.	CG formation ended.

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	Are all FC relationships revertible?	Are all FC sequence numbers equal?	Action to take	Comments
Case 2	SOME - Some FlashCopy pairs are revertible and others are not revertible.	Revertible FlashCopy pairs' sequence numbers are equal. And non-revertible FlashCopy pairs sequence numbers are equal, but do not match the revertible FlashCopies sequence number.	*revert* FC relations.	Some FlashCopy pairs are running in a Consistency Group process and some have not yet started their incremental process.
Case 3	YES.	YES.	*revert* to all FC relations.	All FlashCopy pairs are in a new Consistency Group process and none have finished their incremental process.
Case 4	SOME - Some FlashCopy pairs are revertible and others are not revertible.	YES.	*commit* FC relations.	Some FlashCopy pairs are running in a Consistency Group process and some have already finished their incremental process.

If you see a situation other than the above four situations, then the Global Mirror mechanism has been corrupted.

Case 1: FlashCopies still committed

This indicates the situation where all FlashCopy operations have completed their task (and the next FlashCopy operations have not been started). In this situation, we don't need any action to correct the FlashCopy status because we have consistent data in all C volumes. This state is also reached after the FlashCopies are complete, and Global Mirror is waiting to create the next Consistency Group.

Case 2: FlashCopies partially issued

In this case, there is a group of FlashCopy pairs that are all *revertible* and another group of FlashCopy pairs that are all *non-revertible*. Consistency can be restored if these two criteria are true:

- The FlashCopy sequence number for all revertible pairs is equal.
- The FlashCopy sequence number for all non-revertible pairs is also equal.

This indicates that the FlashCopy operations were interrupted. Some FlashCopy operations for the new consistency group were started, but not all of them.

The FlashCopy relationships that have not started are in a non-revertible state and all of them have the same FlashCopy sequence number. Other FlashCopy relationships that had already started are in a revertible state and all of them have the same FlashCopy sequence number, but the number is different from the sequence number of the non-revertible FlashCopy relationships.

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These indications suggest that you have to return the revertible FlashCopy relationships to the previous Consistency Group doing a FlashCopy FCWITHDR command with the REVERT action to restore the FlashCopy relations to their prior state. You may run this command against all volumes. As stated before, this will do nothing to the non-revertible FlashCopy pairs but return an error message.

Case 3: FlashCopies all revertible

In the case where all of the pairs are revertible and all FlashCopy sequence numbers are equal, this indicates that all FlashCopy operations were running and none completed their task for the Consistency Group formation. This is indicated by the fact that all relationships are still in a revertible state and nothing was finished and committed. Also, all were involved in the very same Consistency Group set with identical FlashCopy sequence numbers. This suggests to return to the previous Consistency Group.

Example 23-6 shows the TSO command FCWITHDR with the REVERT action parameter to roll back the FlashCopy relationship between B and C to the previous Consistency Group.

Example 23-6 Withdraw Global Mirror FlashCopy relationship with ACTION(REVERT)

```
//* ------------------------------------------------------------- ***
//FCWITHDR EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 FCWITHDR  SDEVN(X'6400' TDEVN(X'6500') ACTION(REVERT)
```

The command in Example 23-6 restores the Consistency Group to the prior state, and resets the revertible state to NO. After this command, the FlashCopy relationship is not removed.

When the FlashCopy relationship is not in a revertible state, the withdraw operation is not executed, as Example 23-7 shows.

Example 23-7 FlashCopy withdraw attempt with REVERT to a non-revertible state

```
READY
 FCWITHDR  SDEVN(X'6400') TDEVN(X'6500') ACTION(REVERT)
FLASHCOPY WITHDRAW DEVICE NOT IN A REVERTIBLE STATE
FCWITHDR COMMAND UNSUCCESSFUL FOR DEVICE 6400. COMPLETION CODE: 08
READY
```

Case 4: FlashCopies partially committed

If, at the failure point, some of the FlashCopy operations completed their task to create a consistent copy and committed this process, they are no longer revertible. Other FlashCopy relationships may not have completed their corresponding part of the new Consistency Group; these are still in a revertible state. But all have the same FlashCopy sequence number. So all were involved in the very same Consistency Group. This allows you to commit the revertible FlashCopy relationships. To make the task easier, you may run COMMIT to all FlashCopy pairs. Non-revertible FlashCopy relations would just return an error message.

Example 23-8 shows a FlashCopy withdraw, with ACTION(COMMIT). This commits the FlashCopy relationship to its current state and resets the revertible state to NO. Note again, when you issue this command to FlashCopy pairs that are not revertible any longer, you are going to see only an error message and no action is performed.

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Example 23-8 Withdraw Global Mirror FlashCopy relationship with ACTION(COMMIT)

```
//* ------------------------------------------------------------- ***
//FCWITHDR EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

FCWITHDR  SDEVN(X'6400' TDEVN(X'6500') ACTION(COMMIT)
```

23.7.5 Set consistent data on B volumes

At this point only the C volumes comprise a set of consistent data volumes. The B volumes per definition do not provide consistent data, because Global Copy does not provide data consistency.

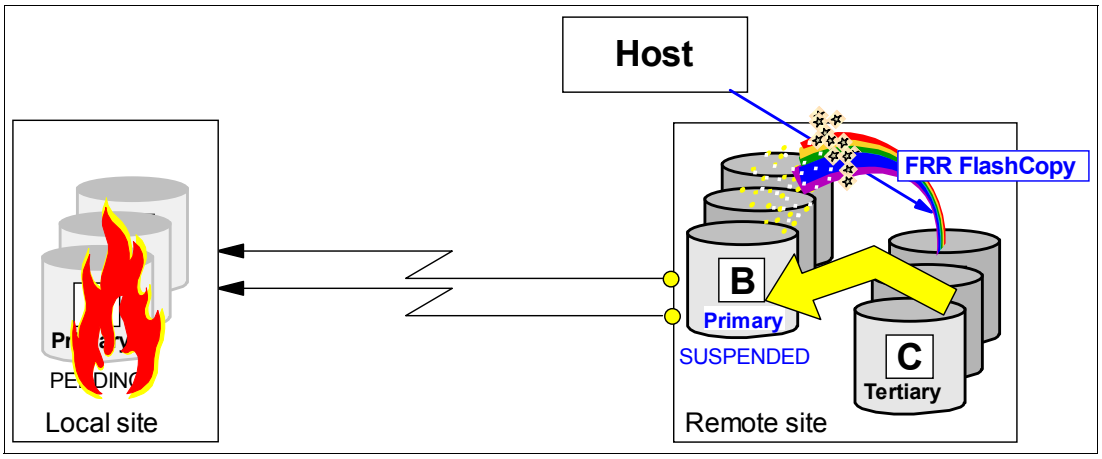

Figure 23-14 Set a consistent set of B volumes using the C volumes as source

We want to have two good copies of the data at the recovery site. The aim is to have a consistent set of volumes to work with, still keeping a good copy to which we can resort if needed. The next step is then to create the same consistency on the B volumes as we have on the C volumes; see Figure 23-14. This can be achieved with the FlashCopy parameter ACTION(FRR) in the FlashCopy establish command (FRR stands for *fast reverse restore)*. The DS CLI also provides this option with the **`reverseflash`** command, with the parameter **`-fast`**.

The command with fast reverse restore is aimed to the FlashCopy target volume (C) as the new FlashCopy source; see Figure 23-14.

Fast reverse restore (FRR) implies the following FlashCopy attributes:

- Start background copy from C to B.
- No change recording.
- Target volume may be a Global Copy primary, which in this case is the suspended Global Copy primary volume. This is needed because when we previously executed the Failover function, we changed the Global Copy secondary from pending to primary suspended.
- Not persistent, which ends this FlashCopy relationship once the background copy completes. This allows you to check that all FRR operations completed before moving on to the next step.

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FRR replicates all data from C to B making a physical copy of C, with some exceptions. Note that the previous *nocopy* relationship between B and C caused some I/Os from B to C. Changed tracks between two Consistency Group creation points will be preserved on the C volume after being copied over from the B volumes before they change there.

These tracks arrive at the C volume between Consistency Group formation and do not contribute to a consistent state because not all required data is physically on the C volume. So after the FRR-triggered background copy from C to B completes, the C volume is actually not usable. You need another step to establish another FlashCopy from B to C to make both volumes really identical. This FlashCopy may be the one you use to create a Global Mirror environment and is going to position the Global Mirror session for a following restart.

But first we perform the FRR from C to B. Example 23-9 illustrates how to do it when using TSO commands.

Example 23-9 Create a consistent set of B volumes

```
//* ---------------------------- TSO ------------- FAILOVER (4) -- ***
//* FLASHCOPY C -> B FAST REVERSE RESTORE (BACKGROUND COPY C -> B) ***
//*        3E00 -> 3C00                                            ***
//*                                                                ***
//* NOTE: WAIT TILL ALL BACKGROUND COPIES COMPLETED BEFORE CONT.   ***
//* NOTE: FRR DOES NOT ALLOW REMOTE(YES)                           ***
//* -------------------------------------------------------------- ***
//FCFRR   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 FCESTABL  SDEVN(X'3E00')  TDEVN(X'3C00') ACTION(FRR)
```

Note that the FlashCopy source volume for this command is the former FlashCopy target volume and vice versa. ACTION(FRR) combines all particular FlashCopy attributes for this action into this single parameter.

You have to wait until all FRR operations complete successfully, before proceeding with the next step. Note that when the background copy completes, the FlashCopy relation will end. This is what you may query to determine when all FRR operations are complete.

23.7.6 Reestablish the FlashCopy relationship between B and C volumes

In this step you establish the former FlashCopy relationship between the B and C volumes, as it was at the beginning when you set up the Global Mirror environment. This step is in preparation for returning later to production at the local site. The command at this step, illustrated in Example 23-10, is exactly the same FlashCopy command you may have used when you initially created the Global Mirror environment. See 22.3.4, “Introduce FlashCopy” on page 257.

Example 23-10 Reestablish FlashCopy between B and C volume with MODE(ASYNC)

```
//* ---------------------------- TSO ------------ CREATE (3) ----- ***
//* FLASHCOPY B -> C START CHANGE RECORDING NOCOPY ETC. THROUGH    ***
//*                  MODE(ASYNC) OPTION (GET READY FOR GM)         ***
//* -------------------------------------------------------------- ***
//* SOURCE AND TARGET REQUIRED                                     ***
//* -------------------------------------------------------------- ***
//FCESTBL EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
```


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```
//SYSTSIN   DD DDNAME=SYSIN

 FCESTABL  SDEVN(X'3C00') TDEVN(X'3E00') MODE(ASYNC)
```

Now you may restart the applications at the remote site using the B volumes. Note the B volumes are Global Copy primary volumes in suspended state, which implies that change recording takes place. Later this allows you to resynchronize from B to A, before returning to the local site.

Eventually, here you may also decide to create another copy of this consistent set of volumes, and create D volumes, or preserve this set of consistent volumes on tape. When you create the D volumes, this is just a plain FlashCopy command. Example 23-11 shows an example with the B volume as FlashCopy source and a new D volume as FlashCopy target.

Example 23-11 Create another set of consistent data volumes

```
//* --------------------------- TSO ------------ CREATE (5) ----- ***
//* FLASHCOPY B -> D TO CREATE COPY TO WORK (TEST) WITH            ***
//* ------------------------------------------------------------- ***
//FCESTBL EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

   FCESTABL  SDEVN(X'3C00')  TDEVN(X'3E02')
```

Note that this is a full volume FlashCopy. This is because at a previous step we reestablished the FlashCopy relationship between B and C, indicating it was part of a Global Mirror environment. This indication carries the *start change recording* attribute, which implies that you can only use the same source volume for full volume FlashCopy—only a single incremental relationship is allowed per source volume.

In a disaster situation you might use the MODE(COPY) for the FlashCopy from B to C, to remove the FlashCopy I/O overhead of MODE(ASYNC), which implies *start change recording* or incremental FlashCopy.

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23.7.7 Restart the application at the remote site

At this stage you may restart the application at the remote site and work with the consistent set of B volumes; see Figure 23-15.

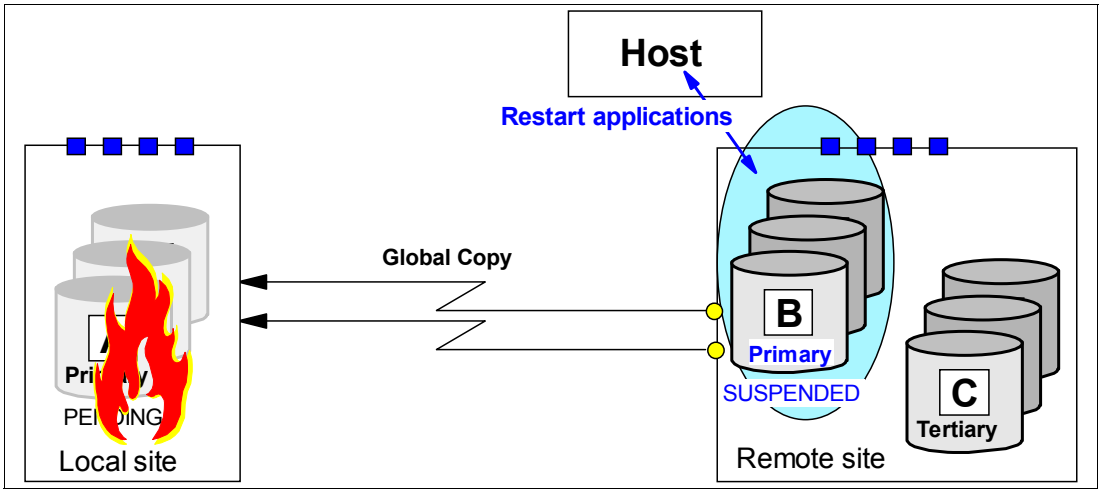

Figure 23-15 Restart applications at remote site

Note the primary suspended state of the B volumes, which implies change recording and indicates the changed tracks on the B volumes.

When the local site is about to become ready to restart the applications again and resume the operations, you prepare the remote site for the next step.

23.7.8 Prepare to switch back to the local site

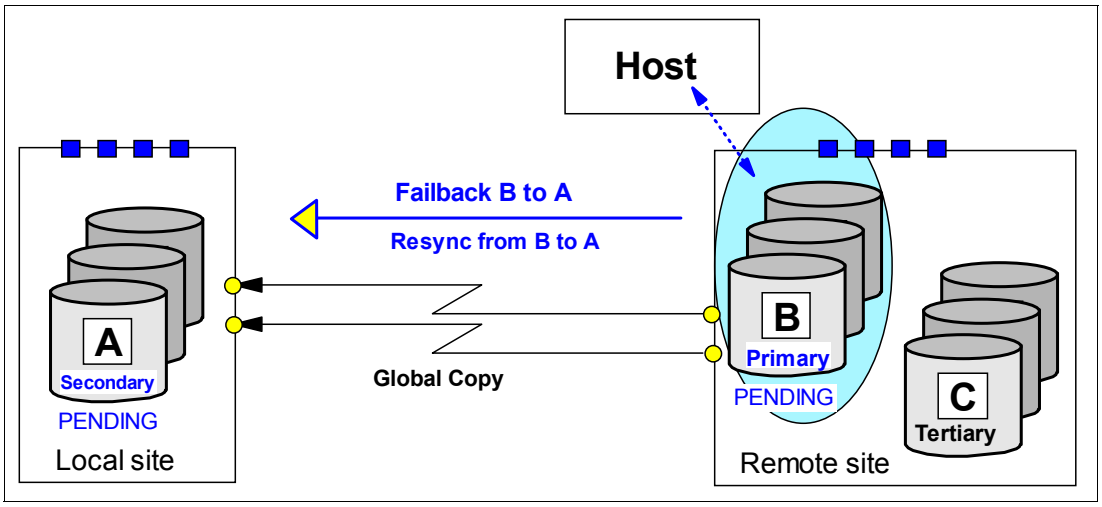

Figure 23-16 Failback operation from B to A in preparation for returning to local site

The local site is back and operative again. We assume that the local site did not lose the data at the time when the swap to the remote site was done. It is then possible to resynchronize the changed data from B to A before restarting the application at the local site. This is accomplished doing a Failback operation (Copy Services Failback function) from B to A; see Figure 23-16.

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Note that the Failback operation is issued to the B volumes as the primary and the A volumes as the secondary. This command changes the A volume from its previous primary pending state to secondary pending and starts the resynchronization of the changes from B to A.

Before doing the Failback operation, ensure that paths are established from the remote site LSS to its corresponding LSS at the local site. Note that with Fibre Channel links you can define paths in either direction on the very same FCP link. During the Failback operation the application stays running at the remote site to minimize the application outage.
Example 23-12 shows a TSO command example for doing the Failback operation.

Example 23-12 Failback operation from B to A before returning to the local site

```
//* ---------------------- FAILBACK B -> A  ------------------- ***
//EPAIRFB EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'3C00')                    +
           PRIM (X'3C00' 73081 X'00' X'0C')  +
           SEC  (X'2C00' 27131 X'00' X'0C')  +
           ACTION(FAILBACK)                  +
           ONLINSEC(NO)  MSGREQ(NO)  CRIT(NO) +
           OPTION  (XD)              CASCADE(NO)
```

A remark on the ONLINSEC parameter here: with ONLINSEC(NO) a verification is done to check whether any connected system has the secondary volume, here device number 2C00, online. If the path group information in the storage disk subsystem reflects that a system has this volume online, the CESTPAIR command will not be executed. This is a safety precaution and protects you from overwriting an online volume by accident. On the other side, there may be a z/VM system, for example, which has this volume also defined, and is IPLed with this device as online during startup. The TSO commands executed in another z/OS system will fail the CESTPAIR.

23.7.9 Return to local site

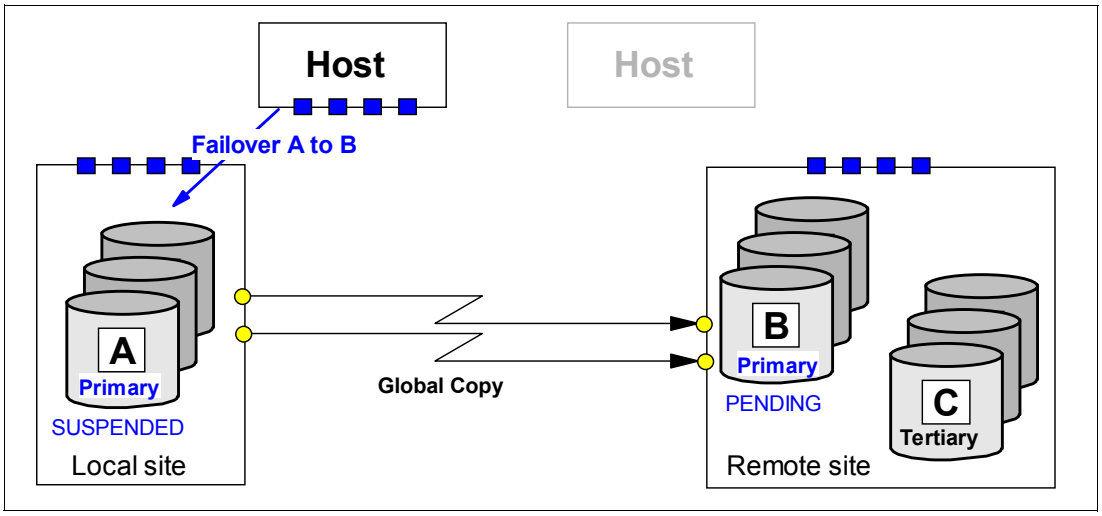

Figure 23-17 Failover from A to B

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Once the local site is ready, quiesce the application at the remote site. Then a sequence of Failover - Failback operations from A to B will reestablish Global Copy back as it was originally before the local site outage.

Figure 23-17 shows the action at the local site, the Failover operation from A to B. This will change the state of the A volumes from secondary pending to primary suspended, and start to keep a bitmap record of the changes to the A volumes.

Once the Failover is completed, a Failback operation from A to B is done; see Figure 23-18.

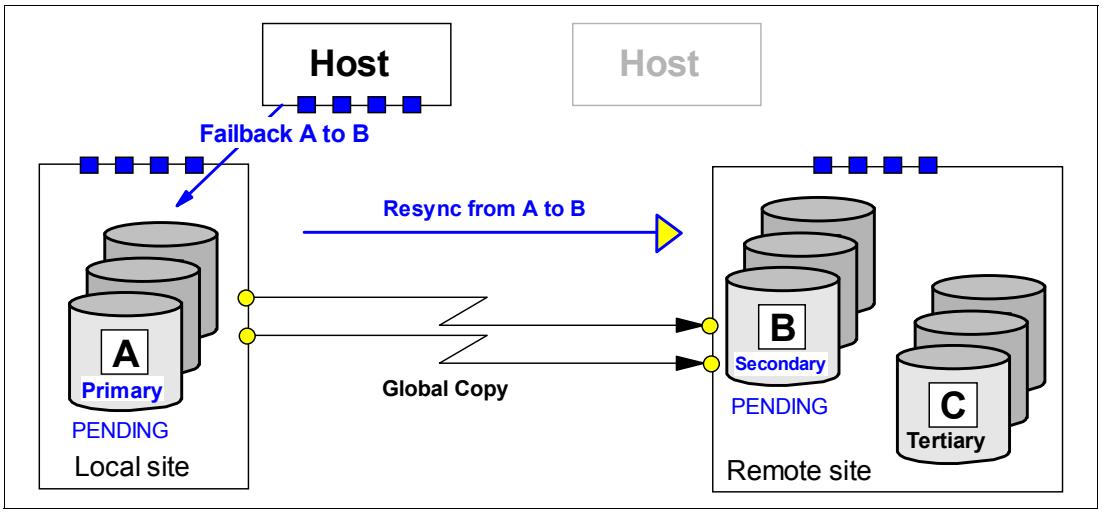

Figure 23-18 Failback from A to B and resync Global Copy volumes

Figure 23-18 shows the Failback operation at the local site. This will change the state of the B volumes from primary pending to secondary pending, and start to replicate updates from A to B.

In our example, the application did not start yet at this point, so there are no updates at the local site. The state of the local volumes A will quickly change from primary suspended to primary pending, which is the normal state for Global Copy pairs.

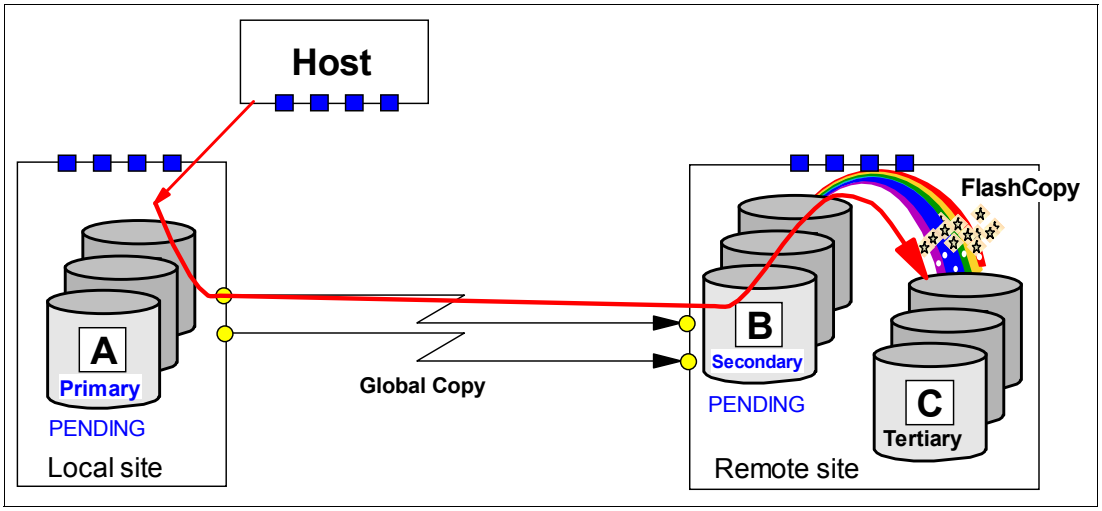

Figure 23-19 Establish Global Mirror FlashCopy relationship between B and C

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Last but not least, if you did not already establish the FlashCopy relationship from B to C during the Failover - Failback sequence at the remote site, then you have to do it now. This may be an inband FlashCopy as shown in Figure 23-19.

A TSO command example is provided in Example 23-13.

Example 23-13 Establish FlashCopy from B to C via inband TSO command

```
//* ---------------------------- TSO ------------ CREATE (3) ----- ***
//* FLASHCOPY B -> C START CHANGE RECORDING NOCOPY ETC. THROUGH    ***
//*                  MODE(ASYNC) OPTION (GET READY FOR GM)         ***
//* ------------------------------------------------------------- ***
//* Inband Command 2C00 is Global Copy primary                     ***
//*                LSS 0C CAA 00 is  Global Copy secondary         ***
//*                                  and FlashCopy source          ***
//*                LSS 0D CAA 00 is  FlashCopy target              ***
//* ------------------------------------------------------------- ***
//FCESTBL EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 FCESTABL  DEVN(X'2C00') SOURCE(73081 00 0C)               +
                         TARGET(73081 00 0D)               +
                         REMOTE(YES) SSID(3C00) MODE(ASYNC)
```

The last step is to start the Global Mirror session again, as shown in Figure 23-20. Then the application may resume at the local site.

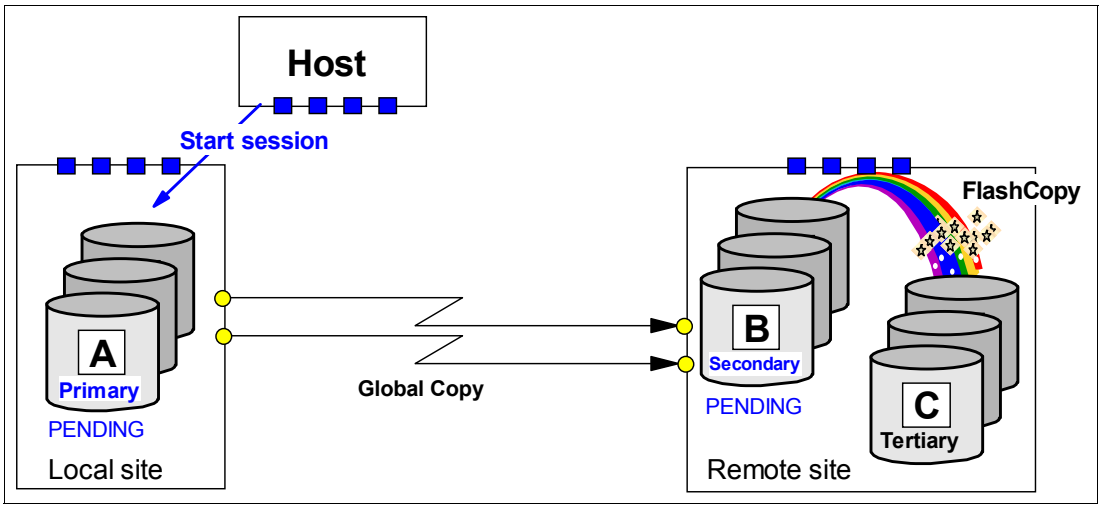

Figure 23-20 Start Global Mirror session and resume application I/O at the local site

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23.7.10 Conclusions

This concludes the sequence of steps you have to go through for a swap to the remote site and coming back to the local site after service is restored at the local site.

In particular, the check on a valid Consistency Group after a primary site failure is a challenge when you consider a large configuration with many volume pairs. Each command usually addresses a single pair of volumes. When you have a large quantity of volume pairs, this requires automation, for example, to check all the FlashCopy relationships after a primary site failure. Note that for a planned site swap, you may not have to check for a valid Consistency Group because, through a proper command sequence and verifying their successful completion, the possibility of an inconsistent group of C volumes is minimal.

Global Mirror is a 2-site solution that can bridge any distance between two sites. There are ready-to-use packages and services available to implement a disaster recovery solution for 2-site remote copy configurations. IBM offers the GDPS and eRCMF service offerings to deliver solutions in this area; see Part 8, “Solutions” on page 431, for more information. You can also visit the IBM Web site and see the Services & Industry Solutions page for more information.

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24

Global Mirror interfaces

In this chapter we provide an overview of the interfaces you can use to manage and control Global Mirror environments. We explain the TSO command support for Global Mirror. We also discuss the use of the DS CLI for managing a Global Mirror configuration in a System z environment, and provide examples. Then we describe the ICKDSF utility and the ANTRQST macro support. Finally, we also discuss the DS Storage Manager Web-based graphical user interface (GUI), which may also be used for Global Mirror management.

The information discussed here can be complemented with the following sources:

- Part 2, “Interfaces” on page 15
- Chapter 9, “FlashCopy interfaces” on page 69
- Chapter 20, “Global Copy interfaces” on page 221
- The examples presented in Chapter 26, “Global Mirror examples” on page 341
- Chapter 31, “IBM TotalStorage Productivity Center for Replication” on page 467
- *z/OS DFSMS Advanced Copy Services*, SC35-0428
- *Device Support Facility User’s Guide and Reference*, SC35-0033
- *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922

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24.1 Global Mirror interfaces - overview

Global Mirror combines Global Copy and FlashCopy, which work together in an autonomic fashion under microcode control. There are commands intended for Global Copy and FlashCopy, as well as commands that address Global Mirror sessions. All of them can be managed with the following interfaces:

- TSO commands
- DS CLI commands
- ICKDSF utility commands
- DS SM Web-based GUI
- ANTRQST macro

Here we give an overview and examples of the use of these interfaces when managing a Global Mirror environment. They are also covered in Part 2, “Interfaces” on page 15.

TotalStorage Productivity Center for Replication (TPC for Replication) provides management of DS6000 series business continuance solutions, including FlashCopy, Metro Mirror, and Global Mirror. TPC for Replication is covered in Chapter 31, “IBM TotalStorage Productivity Center for Replication” on page 467. TPC for Replication includes functions similar to Global Mirror Utility (GMU). GMU users should consider migrating to TPC for Replication.

24.2 Different interfaces for the same function

In this section we show how the same results can be achieved using the different interfaces. The examples provide a first impression of the interfaces and give you an idea of their usability and how they look and feel.

Also, with the examples, you will see that there are differences not only in the look and feel of the different interfaces, but also in the options, parameters, and attributes used to get the same results. For example, FlashCopy within Global Mirror needs the attributes NOCOPY, INHIBIT TARGET WRITE, and START CHANGE RECORDING, but these particular attributes are not explicitly available in all interfaces. For example, the TSO command to create such a particular FlashCopy relationship for Global Mirror combines these three attributes into a single parameter, the MODE(ASYNC) option.

The examples used here show how to establish the FlashCopy relationship between the B and C volumes; see Figure 24-1 on page 299. Note that this is only one step out of the five or six steps to establish a Global Mirror environment.

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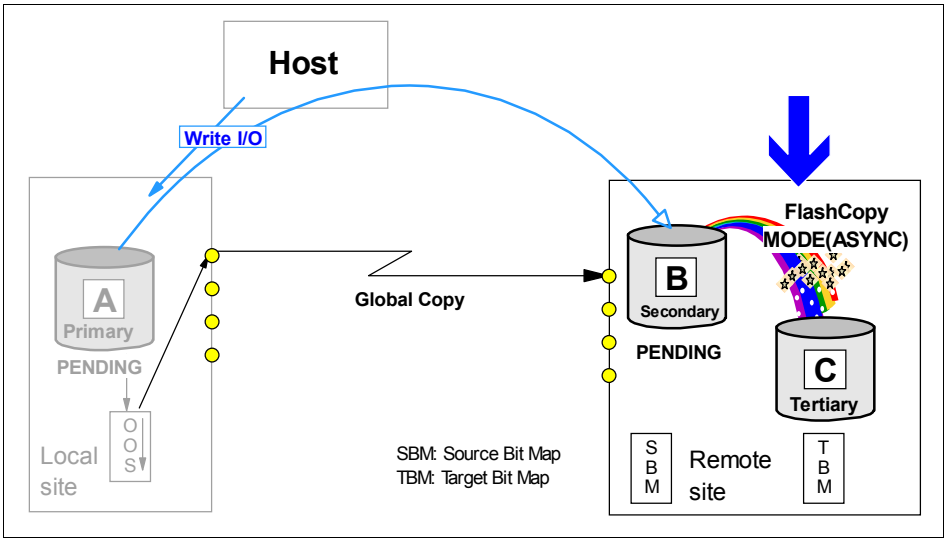

Figure 24-1 Establish FlashCopy relationship within Global Mirror

24.2.1 Establish FlashCopy using TSO

Example 24-1 shows the TSO command that creates the FlashCopy relationship between the B and the C volumes.

Example 24-1 Establish FlashCopy between B and C volumes using a TSO command

```
FCESTABL  SDEVN(X'3C00') TDEVN(X'3E00')  MODE(ASYNC)
```

In the FCESTABL command, the source and target volumes are identified by their z/OS device number. This does not require any further information, such as serial numbers or WWNNs, nor does it need to identify an SMC to address the function. The MODE(ASYNC) parameter implicitly combines all necessary attributes for this FlashCopy relationship: START CHANGE RECORDING, INHIBIT TARGET WRITE, and NOCOPY.

Example 24-2 shows the inband version of this FlashCopy command when the FlashCopy is triggered from the local site. Here the FlashCopy command is issued to the Global Copy primary volume at the local site, and then propagated inband over the paths to the remote site. Note that this example assumes that the Global Copy paths and pairs have already been established.

Example 24-2 inband TSO command to create a FlashCopy between B and C

```
FCESTABL  DEVN(X'2C00') SOURCE(73081 00 0C)  +
                        TARGET(73081 00 0E)  +
                        REMOTE(YES) SSID(3C00) MODE(ASYNC)
```

There is no change for the FlashCopy attributes. The only addition is the addressing of the Global Copy primary volume with the z/OS device address in the DEVN parameter, and the identification of the FlashCopy source and target volumes at the remote site, with the corresponding SOURCE and TARGET parameters. You use inband commands when there is no host channel connection from the local server to the remote storage disk subsystem. Example 24-2 assumes that there is a Fibre Channel connection from the local to the remote storage disk subsystem. It also assumes that the remote devices are defined and configured in the system from where you issue the command.

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24.2.2 Establish FlashCopy using DS CLI

Example 24-3 shows how to create the FlashCopy relationship between the B and the C volumes using the DS CLI command **mkflash**.

Example 24-3 Create FlashCopy between B and C volumes using DS CLI

```
dscli mkflash -record -persist -nocp -seqnum 0000 6500:6502 -cfg
$DSCLI/profile/DS8300-box2.profile
```

The **mklfash** DS CLI command identifies the B and the C volumes through additional information that is found in a configuration file, which usually contains the serial number of the storage disk subsystems.

Example 24-4 shows an example of how this configuration file looks for commands to be run in a DS8000 environment. In this case, it indicates that the commands have to go through the HMC, which is identified by its corresponding IP address. For a DS6000 it also identifies the external SMC with the necessary software stack to handle the Copy Services commands.

Example 24-4 Content of the -cfg file $DSCLI/profile/DS8300-box2.profile

```
hmc1:        192.168.93.14
username:    Jack
password:    Stor123agE
devid:       IBM.2107-7573731
remotedevid: IBM.2107-7506551
```

For simplicity, a required user ID and password is specified in plain text. Administrators of the storage disk subsystem have to set up a user ID and password for users who want to work through the SMC. This information is usually hidden in an encrypted password file.

Example 24-5 shows the creation of a FlashCopy relationship. The source volume and target volume are indicated by the LSS and device number pair 6500:6502. It also indicates the start change recording attribute, which actually implies the persistent attribute. It also indicates the **nocopy** option. An optional FlashCopy sequence number makes it simpler to refer to this FlashCopy relationship in further commands. Note that you may either put the configuration information in the DS CLI command as Example 24-4 shows, or use the configuration file as explained previously.

Example 24-5 Create FlashCopy between B and C with DSCLI and explicit device specifications

```
dscli mkflash -record -persist -nocp -seqnum 0000 6500:6502 -dev ibm.2107-7573731-remotedev
ibm.2107-7506551
```

As shown here in Example 24-6, an inband triggered FlashCopy would require a different DS CLI command, **mkremoteflash**.

Example 24-6 Inband FlashCopy between B and C with DS CLI

```
dscli mkremoteflash -dev ibm.2107-7506551 -conduit ibm.2107-7573731/00 -tgtinhibit -record
-nocp -seqnum 0000 6500:6502
```

The parameter **-conduit** is equivalent to the DEVN TSO parameter in Example 24-2 on page 299. With it you select the primary volume at the local site to where the command is addressed. Note that the DS CLI has to go through an SMC, whereas the TSO commands are directly targeted to the storage disk subsystems by means of the host channel connection.

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24.2.3 Establish FlashCopy using ICKDSF

ICKDSF is usually the interface that is used to manage remote copy configurations in z/VM and z/VSE environments. It is a batch-oriented approach and requires the JCL to invoke ICKDSF. Example 24-7 shows the FlashCopy command used to create a Global Mirror FlashCopy relationship.

Example 24-7 Create FlashCopy between B and C using ICKDSF

```
//* ------------------------------------------------------------ ***
//FCBTOC  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//SYSIN     DD *

  FC   UNIT(3C00)   ESTABLISH          -
       TARGETVOL    (X'0E',X'00',3E00) -
       CHRCD        (YES)              -
       NOTGTWT      (YES)              -
       MODE         (NOCOPY)
```

ICKDSF also lists the individual attributes that are required to create a FlashCopy relationship for Global Mirror.

Example 24-8 shows an inband FlashCopy that is given with ICKDSF at the local site, and addresses the remote site.

Example 24-8 Inband FlashCopy between B and C using ICKDSF

```
//* ------------------------------------------------------------ ***
//FCBTOCIN EXEC PGM=ICKDSF
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSPRINT  DD SYSOUT=*
//SYSIN     DD *

 FC      DDNAME(DD01)     ESTABLISH                            -
         SRCVOL           (X'00',X'00',X'0002' AAVCA)          -
         TGTVOL           (X'00',X'00',6500)                   -
         CHRCD            (YES)      /* CHANGE RECORDING       */ -
         NOTGTWR          (YES)      /* INHIBIT TARGET WRITES  */ -
         MODE             (NOCOPY)   /* NO BACKGROUND COPY     */ -
         TGTCANCOMEONLINE (NO)
```

Note the syntax variation in the SRCVOL and TGTVOL parameters, when hex notation is used and when it is not used. In the SRCVOL parameter, the serial number of the storage disk subsystem is not in hex notation, but all the other parameters are. The TGTVOL parameters are also in hex notation, except for the z/OS device number of the FlashCopy target volume.

24.2.4 Which interface to choose

Which interface you choose depends on your preferences and the experience you gathered in the past. In our examples, we left out the DS Storage Manager GUI, which is another alternative. A fully automated solution such as GDPS relieves you of the decision as to which interface to use to manage the Global Mirror environment.

When you set up your own Global Mirror management package, you have the choice of which interface to use.

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TSO commands

TSO commands are submitted using an inband approach over the host channel directly to the storage disk subsystem. No active SMC or DS SM is required to trigger Copy Services functions.

You can issue the TSO commands from procedures that are similar to the scripting approach in open systems environments.

Note that TSO requires a z/OS system at the recovery site when you recover a Global Mirror environment at the remote site.

DS CLI

The strength of DS CLI is its scripting capability. You can easily create and modify script files. From a syntax level, the DS CLI looks a bit more complicated, and it tends to extend single lines for single commands, which makes it harder to read when you have to maintain such script files. Again, this may be a matter of experience.

ICKDSF

ICKDSF is the only direct interface for z/VM and z/VSE environments. It is also very quick, just as the TSO commands are, because it does not need other components and networks in-between to trigger Copy Services functions.

DS Storage Manager

The DS Storage Manager provides a Web-based graphical user interface (GUI), which makes it friendly and user oriented. It is best suited for when you need to perform ad hoc actions, and creating a script would be too time-consuming. It is not the best choice when you have to set up a big and complex Global Mirror environment.

ANTRQST Macro

We do not cover the ANTRQST macro here. This macro is used by software automation routines to provide full function management of Global Mirror. GDPS is an example.

Again, it is mostly your choice, depending on personal preferences and experience. When you have no bias, we consider TSO commands the preferable interface for managing Global Mirror in a z/OS environment. Through the inband approach over host channels and without other agents in-between, TSO commands execute very quickly. The TSO command syntax is also rather simple. TSO is an integral part of z/OS standard software, which stands for reliability, availability, and serviceability.

24.3 Global Mirror management using TSO commands

TSO commands are commonly used in z/OS environments to manage remote copy configurations. TSO commands may also be executed from REXX or CLIST procedures.

TSO commands have the advantage that they do not need a DS6000 SMC, nor an ad hoc storage management server. They are directly forwarded, via an inband approach, to the storage disk subsystem. This happens over the host channel connection, which usually is FICON. This inband characteristic allows a very quick command transfer—it does not have to go through software stacks in the storage server microcode.

When working with Copy Services, TSO commands generally use a z/OS device number to aim for the device, LSS, or storage disk subsystem. Still, with Global Mirror, TSO commands require an online VOLSER as a parameter.

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24.3.1 Establish a Global Mirror environment

The following sections discuss the setup of a Global Mirror environment using TSO commands in a step-by-step approach. The sequence of steps in our example is the recommended one, although it is not a mandatory one. Still, it guarantees a clean and straightforward creation of the Global Mirror environment.

24.3.2 Define paths

When you establish Global Copy relationships between volume pairs, you have to first establish the Global Copy paths. A Global Copy path, similar to a Metro Mirror path, is the logical definition of the connectivity between two LSSs, the primary LSS and the secondary LSS. This definition is accomplished upon an available physical Fibre Channel link that connects the primary and secondary storage disk subsystems where the corresponding LSSs are. More than one path can be defined over a single Fiber Channel link. You can also define paths in either direction on the very same physical link.

The FCP links that provide the physical support for the logical path definitions are either direct-connected or can use the SAN infrastructure. In the latter case, the FCP ports can be shared with either other remote copy connections or with host connections. Still, you may consider dedicated ports, thus separating host I/O from remote copy I/O, which is recommended for Metro Mirror. For Global Copy and Global Mirror it is feasible to consider an FCP port sharing approach.

Figure 24-2 shows two LSSs, one on each storage disk subsystem, with both storage disk subsystems connected either directly or over the SAN. The figure shows four physical links, each link connecting to an FCP port. Because the storage disk subsystems are separated over a large distance, these links are either going through an SAN network, or over an IP-based network. There is no distance limit for a Global Mirror configuration.

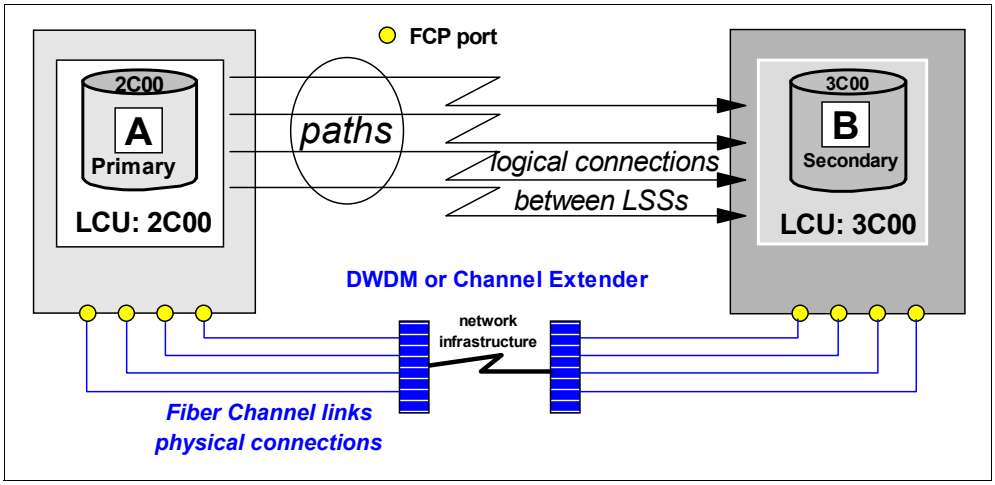

Figure 24-2 Paths definition between two LSS

Example 24-9 shows the TSO command that is used to define the four logical paths, at once, between the primary LSS and the secondary LSS. If using TSO commands, there is no change in how to define a path on the DS6000 or the DS8000, as compared to the ESS 800.

Example 24-9 Define logical paths

```
//* --------------------------- TSO ------------ CREATE (1) ----- ***
//* ESTABLISH PATH(S)                                             ***
//* ------------------------------------------------------------- ***
```


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```
//EPATHS  EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

   CESTPATH  DEVN (X'2C00')                          +
             PRIM (X'2C00' 5005076303FFC228  X'0C') +
             SEC  (X'3C00' 5005076303FFC422  X'0C') +
             LINK (X'00300030' X'01300130'          +
                   X'02300230' X'03310330') CGROUP(NO)
   CQUERY    DEVN (X'2C00') PATHS
```

Primary and secondary LSSs are identified by their respective subsystem IDs (SSIDs), the WWNN of the storage disk subsystem, and the LSS number. The LINK parameter contains the System Adapter ID (SAID), the source port ID, and the target port ID. A path definition connects two individual LSSs. For each LSS pair you repeat the command, each time adjusting the SSID and LSS numbers accordingly. Note that for Global Copy it does not make sense to establish the CGROUP attribute that triggers the extended long busy (ELB) condition.

Define paths for multiple primary storage disk subsystems

If, for a Global Mirror session, you intend to use Global Copy primary volumes from LSSs from multiple primary storage disk subsystems, one thing you need to do is to define the corresponding Global Mirror session paths between these primary storage disk subsystems. These paths allow communication between the Master and the Subordinates; see Figure 24-3.

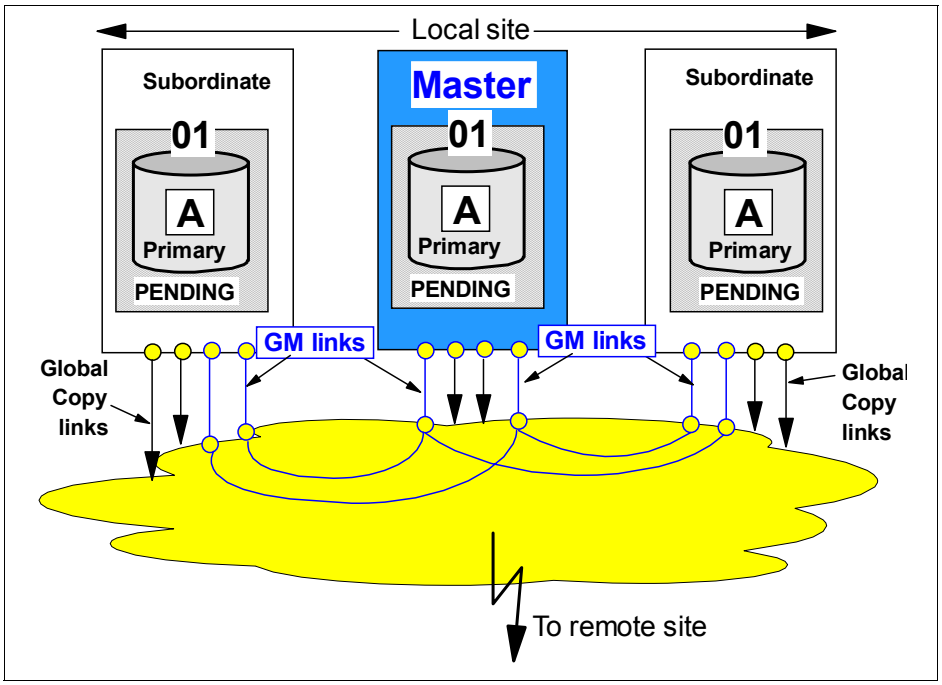

Figure 24-3 Define paths between local primary storage disk subsystems; decide on a Master

This is a conventional CESTPATH command where you specify the Master storage disk subsystem as the primary, and the corresponding Subordinates as the secondary storage disk subsystems. At this time you decide which storage disk subsystem will become the Master. Any LSS in the Subordinate storage disk subsystems is eligible for establishing the Master - Subordinate relationship needed for the Global Mirror session.

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For redundancy reasons it is better to define two paths between the primary disk subsystems. Note that the FCP ports may be shared using a SAN fabric. See Figure 24-3.

24.3.3 Establish Global Copy volume pairs

After defining the paths, you create the Global Copy volume pairs.

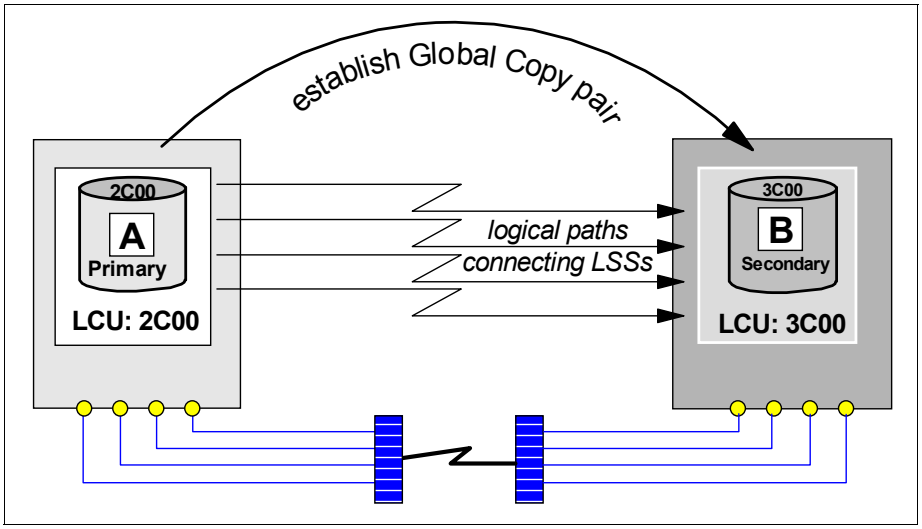

Figure 24-4 Establish a Global Copy pair

Figure 24-4 illustrates a Global Copy pair relationship between the primary A volume and the secondary B volume. This relationship is maintained over the four logical paths that connect the corresponding LSSs. These paths were defined in Example 24-9 on page 303.

Example 24-10 shows the TSO command used to define the Global Copy pair relationship.

Example 24-10 Define Global Copy pair relationship using TSO command

```
//* ---------------------------- TSO ------------ CREATE (2) ----- ***
//* ESTABLISH GLOBAL COPY PAIR(S)                                  ***
//* ---------------------------------------------------------------- ***
//EPAIR   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'2C01')                      +
           PRIM (X'2C00' 27131 X'01' X'0C')    +
           SEC  (X'3C00' 73081 X'01' X'0C')    +
           ONLINSEC(NO)  MSGREQ(NO)   CRIT(NO) +
           OPTION  (XD)  MODE  (COPY) CASCADE(NO)
```

OPTION(XD) indicates a Global Copy relationship. Once the command successfully ends, Global Copy immediately does an initial copy of the primary volumes. Example 24-11 on page 306 shows the output information from a query command to the primary volume. You can see the pending.XD volume state, and the number of tracks out of sync, all of which is expected for a Global Copy pair relationship that is in its initial replication phase.

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Example 24-11 Query Global Copy pair immediately after ESTABLISH

```
CQUERY    DEVN(X'2C00')
 CQUERY FORMATTED LVL 3
 VOLUME REPORT
 ********************* COPY CQUERY - VOLUME **********************
 *                                          (PRIMARY)   (SECONDARY) *
 *                                         SSID CCA LSS SSID CCA LSS*
 *DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
 *------ ---------  ----------  ----------- ---------    ---------  *
 * 2C00  PRIMARY..  PENDING.XD   ACTIVE..   2C00 00 0C   3C00 00 0C *
 *       CRIT(NO).......       CGRPLB(NO). 000000027131 000000073081*
 * PATHS PFCA SFCA STATUS: DESCRIPTION                              *
 * ----- --------- ------  ------------------                       *
 *   4   0030 0030   13    PATH ESTABLISHED...                      *
 *       0130 0130   13    PATH ESTABLISHED...                      *
 *       0230 0230   13    PATH ESTABLISHED...                      *
 *       0331 0330   14    (UNDETERMINED).....                      *
 * IF STATE = PENDING/SUSPEND:    TRACKS OUT OF SYNC =   49599      *
 *                                TRACKS ON VOLUME   =   50085      *
 *                               PERCENT OF COPY COMPLETE =   1%    *
 *  SUBSYSTEM         WWNN                  LIC LEVEL               *
 * -----------  ----------------           -----------             *
 * PRIMARY....  5005076303FFC228           5.0.03.0097             *
 * SECONDARY.1  5005076303FFC422                                   *
 ********************************************************************
 CQUERY COMMAND COMPLETED FOR DEVICE 2C00. COMPLETION CODE: 00
```

Example 24-12 provides the same information as Example 24-11, but in a space-saving unformatted format.

Example 24-12 Unformatted query output

```
CQUERY    DEVN (X'2C00') UNFORMAT
 CQUERY UNFORMATTED LVL 3
 VOLUME REPORT
 2C00,PRIMARY,PENDING XD,ACTIVE,
 2C000C,00,000000027131,3C000C,00,000000073081,N,N,
 1,00300030,13,01300130,13,02300230,13,03310330,14,
 0047599,0050085,005,
 5005076303FFC228,5005076303FFC422,
```

Once the initial replication phase is completed, the CQUERY command output will not show the TRACKS OUT OF SYNC information; see Example 24-13 on page 307. Note that at a later point-in-time, you may again observe the TRACKS OUT OF SYNC portion of the report, as Example 24-11 showed, but then it is not related to the first replication phase.

Tip: The recommendation is to wait until this first replication phase is finished before you proceed to establish the Global Mirror FlashCopy relationships between the B and C volumes.

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Example 24-13 Global Copy after first replication phase is completed

```
CQUERY    DEVN(X'2C00')
 CQUERY FORMATTED LVL 3
 VOLUME REPORT
 ********************* CQUERY - VOLUME ***************************
 *                                          (PRIMARY)   (SECONDARY) *
 *                                         SSID CCA LSS SSID CCA LSS*
 *DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
 *------ ---------  ----------  ----------- ---------    ---------  *
 * 2C00  PRIMARY..  PENDING.XD   ACTIVE..   2C00 00 0C   3C00 00 0C *
 *       CRIT(NO).......       CGRPLB(NO). 000000027131 000000073081*
 * PATHS PFCA SFCA STATUS: DESCRIPTION                              *
 * ----- --------- ------  -------------------                      *
 *   4   0030 0030   13    PATH ESTABLISHED...                      *
 *       0130 0130   13    PATH ESTABLISHED...                      *
 *       0230 0230   13    PATH ESTABLISHED...                      *
 *       0331 0330   14    (UNDETERMINED).....                      *
 *  SUBSYSTEM         WWNN                   LIC LEVEL             *
 * -----------  ----------------           -----------             *
 * PRIMARY....  5005076303FFC228           5.0.03.0097             *
 * SECONDARY.1  5005076303FFC422                                   *
 ********************************************************************
 CQUERY COMMAND COMPLETED FOR DEVICE 2C00. COMPLETION CODE: 00
```

24.3.4 Establish FlashCopy relationships for Global Mirror

Once the Global Copy pairs complete their initial replication phase, you must create the FlashCopy relationships between the B and C volumes; see Figure 24-5.

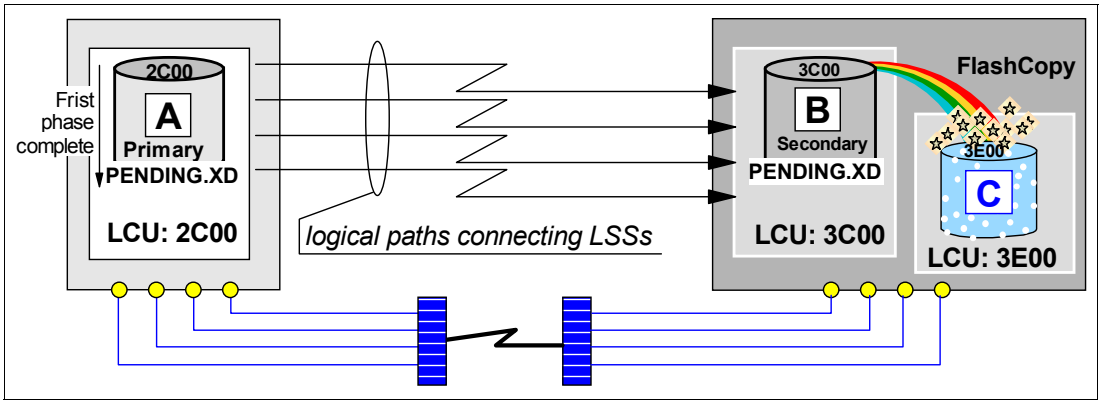

Figure 24-5 Establish Global Mirror FlashCopy relationship between B and C

Because these FlashCopy relationships are part of a Global Mirror configuration, they are defined with a set of particular attributes; see the discussion in 22.3.4, “Introduce FlashCopy” on page 257.

Example 24-14 shows a TSO command that is issued at the local site, and upon its inband propagation to the remote site, establishes the FlashCopy relationship between the B and C volumes at the remote disk subsystem.

Example 24-14 TSO command to create a FlashCopy pair between B and C volumes

```
FCESTABL  DEVN(X'2C00') SOURCE(73081 00 0C)               +
                        TARGET(73081 00 0E)               +
                        REMOTE(YES) SSID(3C00) MODE(ASYNC)
```


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The inband modality is used when the remote site is not connected to the local site. DEVN refers to the primary volume, and SOURCE and TARGET refer to remote storage disk subsystem. MODE(ASYNC) implicitly includes the specific FlashCopy attributes that are required for Global Mirror.

24.3.5 Define a Global Mirror session

Before adding volumes to the Global Mirror session, a token is required under which the session can be identified and addressed.

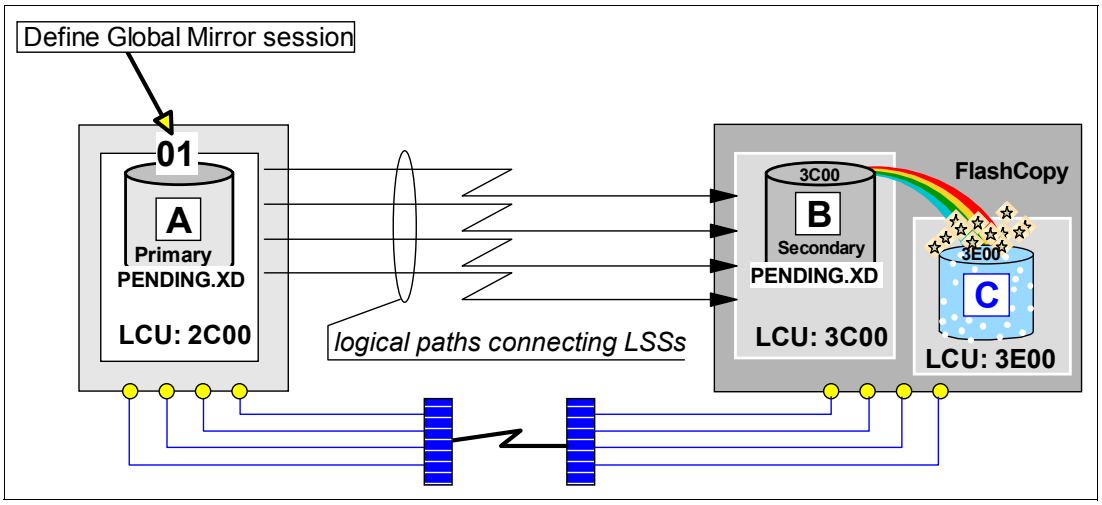

Figure 24-6 Define a Global Mirror session number

Figure 24-6 shows a volume within an LSS. This LSS contains the Global Copy primary volumes that are going to be part of the Global Mirror session. At the moment it is recommended to use some kind of utility device within each LSS, for addressing purposes. This utility device needs to be online to the z/OS system where you execute the Global Mirror commands. You may consider using a volume that will not be part of the Global Mirror session, but within the same LSS where the Global Copy primary volumes will be.

Example 24-15 TSO command example to define a Global Mirror session

```
//* ---------------------------- TSO ------------ CREATE (4) ----- ***
//* DEFINE GM SESSION NUMBER X'01' TO LSS X'0C' AND LSS X'0D'      ***
//* ------------------------------------------------------------- ***
//DEFSESS EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RSESSION   SNBR(01) VOLSER(XX2C00)          +
             ACTION(DEFINE)                   +
             LSSTYPE(CKD) LSSNBR(0C)          +
             ESSSERIAL(27131)                 +
             MSSERIAL (27131)

  RSESSION   SNBR(01) VOLSER(XX2D00)          +
             ACTION(DEFINE)                   +
             LSSTYPE(CKD) LSSNBR(0D)          +
             ESSSERIAL(27131)                 +
             MSSERIAL (27131)
```


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The TSO command RSESSION is used to set up and manage a Global Mirror session; see Example 24-15. This includes the ability to define a Global Mirror session by means of the ACTION(DEFINE) parameter option. Other options that can be specified for the ACTION parameter are: START and STOP a Global Mirror session, as well as PAUSE and RESUME of the session, or to UNDEFINE the session.

This example also shows that you have to define this Global Mirror session number to all LSSs at the primary site that will hold the Global Copy primary volumes that are going to be part of this session.

As with all TSO commands, you can issue this command interactively through ISPF menu 6, or from the TSO READY status. In the z/OS SYSLOG this RSESSION command is only logged as the command itself but not the response to this command. It is, therefore, recommended to always use TSO in batch for documentation purposes and to be able to track all commands and their outcomes.

24.3.6 Populate a Global Mirror session with volumes

After you successfully defined a Global Mirror session, you populate the session with the Global Copy primary volumes. These are all the primary A volumes that are going to participate in the Global Mirror session at the local site; see Example 24-16.

Example 24-16 Add Global Copy primary volumes to Global Mirror session

```
//* ---------------------------- TSO ------------ CREATE (5) ----- ***
//* POPULATE SESSION X'01' WITH PRIMARY VOLUMES                     ***
//*                                                                 ***
//*          VOLUME LIST CONTAINS CCA NUMBERS                       ***
//* --------------------------------------------------------------- ***
//JOIN    EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RVOLUME    SNBR(01) VOLSER(XX2C00)          +
             ACTION   (JOIN)                  +
             LSSTYPE  (CKD) LSSNBR(0C)        +
             ESSSERIAL(27131)                 +
             VOLLIST  (00)

  RVOLUME    SNBR(01) VOLSER(XX2D00)          +
             ACTION   (JOIN)                  +
             LSSTYPE  (CKD) LSSNBR(0D)        +
             ESSSERIAL(27131)                 +
             VOLRANGE (00:01)
```

Example 24-16 shows the TSO command RVOLUME. To populate the Global Mirror session with Global Copy volumes you use the ACTION(JOIN) parameter value.

With this command you also remove the Global Copy primary volumes from the session. The corresponding parameter value for this action is ACTION(REMOVE).

With the VOLLIST or VOLRANGE parameters, you define the volumes that are added to the session or removed from the session. VOLLIST is a list of channel connection addresses (CCA) that identify the A volumes. VOLRANGE allows you to specify a range of CCAs. In Example 24-16, a volume with CCA x'00' from LSS x'0C' is added to the session number x'01'. Two more volumes from LSS x'0D'are added to the session. This is indicated by the VOLRANGE parameter value 00:01, which adds volumes from CCA x'00' to CCA x'01'.

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24.3.7 Start a Global Mirror session

The new RSESSION command is used to start the Global Mirror session. With the ACTION(START) parameter, you indicate the start of the Consistency Groups formation.

Example 24-17 Start Global Mirror session

```
//* ---------------------------- TSO ------------ CREATE (6) ----- ***
//* START    SESSION X'01' THROUGH LSS X'0C'                       ***
//*                                                                 ***
//*          THEN LSS X'0C' BECOMES THE MASTER LSS (DS)             ***
//*          NOTE: LSS SYNTAX IS WITHOUT X AND QUOTES ...           ***
//*                                                                 ***
//*          CGINTERVAL - BUILD CG WITHOUT A BREAK                  ***
//*          CGDRAIN    - ALLOW 10 MINUTES FOR DRAINING             ***
//*          COORDINTERVAL - ALLOW 5 MS MAX FOR COORDINATION        ***
//* ----------------------------------------------------------------- ***
//START   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RSESSION   SNBR(01)      VOLSER(XX2C00)    +
             ACTION       (START)            +
             LSSTYPE      (CKD) LSSNBR(0C)   +
             ESSSERIAL    (27131)            +
             MSSERIAL     (27131)            +
             CGINTERVAL   (00)               +
             CGDRAIN      (600)              +
             COORDINTERVAL(05)
```

Example 24-17 shows the START command that begins the formation of Consistency Groups for session number x'01'. Besides the ACTION parameter, you address the LSS number that receives this command. This also defines the Master LSS, which is LSS number x'0C'.

You may override the default values of the Global Mirror session parameters. In our example we keep the default value for CGINTERVAL, but we change the defaults for CGDRAIN to 10 minutes as the maximum Consistency Group Drain time. We also change the maximum coordination time COORDINTERVAL to 5 ms.

24.3.8 Query a Global Mirror session

To obtain status information about the Global Mirror session, we use the RQUERY command. Example 24-18 shows an RQUERY command example.

Example 24-18 New TSO RQUERY command

```
RQUERY SNBR(01) VOLSER(volser) ACTION(action) LSSNBR(lss) LSSTYPE(type) DVCNBR(###)
```

The following parameters are used with this command:

- SNBR indicates the Global Mirror session number from which a query report is requested. This parameter is optional. When omitted, RQUERY will report all session numbers that are available in the addressed primary storage disk subsystem.
- VOLSER indicates an online z/OS volume serial number. This utility volume is used to address the RQUERY command to the particular LSS where the query report is requested.

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- ACTION is required and specifies which kind of query report is requested. Three different query reports can be requested with this parameter:
  - GMLSTAT provides summary information pertaining to the Global Mirror session. This includes information about the Master storage disk subsystem, the Subordinate storage disk subsystems, as well as the number of successfully created Consistency Groups and how often Consistency Group creation failed. It also includes the parameter values for the session.
  - GMPSTAT provides Global Mirror summary status information of the LSS addressed in the VOLSER parameter. Key information from this query is the number of tracks that are still in the out-of-sync bitmap at the primary LSS, and are waiting to be replicated to the corresponding secondary LSS. This query also details the total number of Global Mirror volumes within this LSS, and how many volumes out of the total contain out-of-sync tracks.
  - DVCSTAT provides an overview of all involved devices in a Global Mirror session for the LSS addressed in the VOLSER parameter.
- LSSNBR specifies the LSS number for which we query information. This parameter is required when LSSTYPE(FB) is specified. It is not required when LSSTYPE is CKD (default).
- LSSTYPE identifies whether this is an LSS with fixed blocked (FB) devices for open systems or count-key-data (CKD) devices for System z. CKD is the default.
- DVCNBR indicates the LUN for which the query report is requested, and is required when LSSTYPE(FB) is specified.

Example 24-19 shows an RQUERY command with ACTION(GMLSTAT). The example shows the formatted line output information for the LSS that has VOLSER(XX2C00) in it.

Example 24-19 RQUERY TSO command example with ACTION(GMLSTAT)

```
  RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(GMLSTAT)
RQUERY Output Volser(XX2C00) Action(GMLSTAT) Version(001)
SNbr GMLStat    GoodCg   Pct CrnBadCG TotBadCG LastGoodCGSCntlClock
--   ---------- -------- --- -------- -------- --------------------
01   Running    00000001 100                   19 May 2005 22:02:35
.
Master: Serial       SSID LSS   CGInt CGDrn CrdInt
        ------------ ---- --    ----- ----- -----
        000107527131 2C00 0C        0   600     5
READY

  RQUERY     SNBR(01) VOLSER(XX2D00) ACTION(GMLSTAT)
RQUERY Output Volser(XX2D00) Action(GMLSTAT) Version(001)
SNbr GMLStat    GoodCg   Pct CrnBadCG TotBadCG LastGoodCGSCntlClock
--   ---------- -------- --- -------- -------- --------------------
01   NoConfig
READY
```

Example 24-19 shows a second RQUERY command. The first command was issued to the Master LSS of the Global Mirror session. The second command is issued to another LSS that is not a Master LSS.

In the output information, besides the information related to the Master LSS, there is also information about the number of Consistency Groups created, the number of failed attempts, and the last successfully created Consistency Group with the internal time stamp from the storage disk subsystem. The status of the Global Mirror session is also important.

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Example 24-19 shows for this status *Running*. Refer to *z/OS DFSMS Advanced Copy Services*, SC35-0428, for a description of different status indications.

Example 24-20 shows Global Mirror status information for a particular LSS and its Global Copy primary volumes, when ACTION(GMPSTAT) is used with the RQUERY command.

Example 24-20 RQUERY TSO command example with ACTION(GMPSTAT)

```
READY
   RQUERY     SNBR(01) VOLSER(XX2D00) ACTION(GMPSTAT)
 RQUERY Output Volser(XX2D00) Action(GMPSTAT) Version(001)
 SNbr LSS GMPStatus  TotVol OOSVol OOSTrks
 --   --  ---------- ------ ------ --------
 01   0D  CGInPrgrs  2      2      00003E02
 READY
 END
```

The formatted output provides the following information:

- LSS number 0D contains 2 volumes in the session number 01 (SNbr, LSS, and TotVol).
- Both volumes contain tracks that are not yet replicated by Global Copy to their corresponding secondary volumes (OOSVol).
- The number of out-of-sync tracks is indicated in hexadecimal (OOSTrks).
- Consistency Group formation is in process for this LSS (GMPStatus).

Example 24-21 shows two TSO RQUERY commands with ACTION(DVCSTAT). One command is addressed to LSS 0C and the other to LSS 0D. They both show, for the corresponding LSS, individual information for the Global Copy primary volumes that are in the Global Mirror session. These devices are: device with CCA x'00' in LSS x'0C', and devices with CCA x'00' and x'01' in LSS x'0D'.

Example 24-21 RQUERY Global Copy primary volumes in premature status

```
READY
   RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(DVCSTAT)
 RQUERY Output Volser(XX2C00) Action(DVCSTAT) Version(001)
 SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
 --   --  --  -------------------- ----------  ----------
 01   0C  00  NIn+JoinP+1st        DplxPendng  Simplex
 READY
   RQUERY     SNBR(01) VOLSER(XX2D00) ACTION(DVCSTAT)
 RQUERY Output Volser(XX2D00) Action(DVCSTAT) Version(001)
 SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
 --   --  --  -------------------- ----------  ----------
 01   0D  00  NIn+JoinP+1st        DplxPendng  Simplex
      0D  01  NIn+JoinP+1st        DplxPendng  Simplex
 READY
```

Example 24-21 shows that the volumes in both LSSs are still not in session, are in their initial copy phase, and have not completed their first pass.

Example 24-22 on page 313 shows the very same RQUERY TSO commands as in the previous example, but this time the initial copy phase is complete and all volumes are in session, which means they participate in the Consistency Groups formation at the remote site.

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Example 24-22 Global Copy primary volumes in Global Mirror session

```
READY
   RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(DVCSTAT)
 RQUERY Output Volser(XX2C00) Action(DVCSTAT) Version(001)
 SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
 --   --  --  -------------------- ----------  ----------
 01   0C  00  InSession            DplxPendng  Simplex
 READY
   RQUERY     SNBR(01) VOLSER(XX2D00) ACTION(DVCSTAT)
 RQUERY Output Volser(XX2D00) Action(DVCSTAT) Version(001)
 SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
 --   --  --  -------------------- ----------  ----------
 01   0D  00  InSession            DplxPendng  Simplex
      0D  01  InSession            DplxPendng  Simplex
 READY
```

For more details and different VolStat indications, refer to *z/OS DFSMS Advanced Copy Services*, SC35-0428.

24.4 DS CLI to manage Global Mirror volumes in z/OS

The DS CLI has a set of commands that are common between the DS6000, the DS8000, and the ESS 800 (from LIC level 2.4.3 and above), to manage a Copy Services environment. Although remote mirror and copy functions over Fibre Channel links is supported since ESS 800 LIC level 2.3.0+, the newer LIC level is required for the ESS 800 to support the new DS CLI commands.

Refer to Chapter 26., “Global Mirror examples” on page 341 for examples of how to use DS CLI for Global Mirror management in a System z environment. Also refer to Chapter 4, “DS Command-Line Interface” on page 25.

24.5 Global Mirror management using ICKDSF

ICKDSF used to be a disk management tool to initialize and diagnose disk volumes. Over time it evolved and today ICKDSF contains functional support to manage all available Copy Services functions.

ICKDSF supports all System z-based operating systems including z/OS, z/VM, and VSE/ESA™. Therefore, ICKDSF is a common platform for all System z operating systems to provide an interface to the DS6000, DS8000, and ESS 800 Copy Services functions. This includes all of Metro Mirror, Global Copy, Global Mirror, and FlashCopy.

24.5.1 Establish a Global Mirror environment

The following sections discuss how to set up a Global Mirror environment with ICKDSF. The sequence of steps we show in our discussion, although not mandatory, is the recommended one for the creation of a Global Mirror environment.

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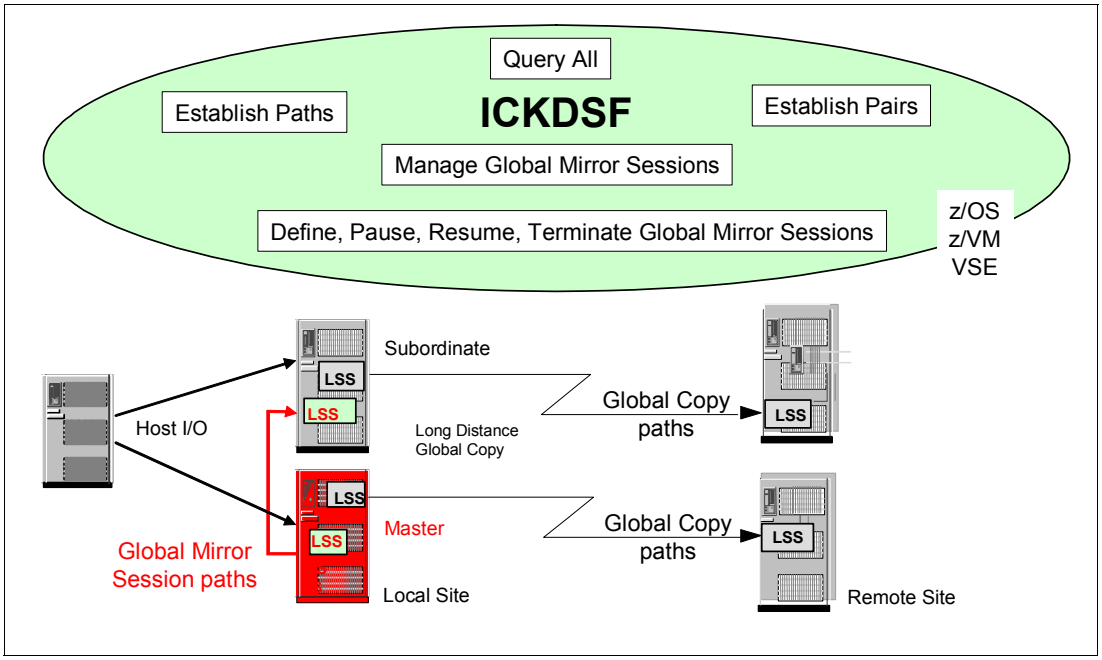

Figure 24-7 ICKDSF support for Global Mirror

Figure 24-7 provides the complete picture of a Global Mirror session. ICKDSF is used to:

- Establish Global Mirror and Global Copy paths
- Establish Global Copy pairs
- Create FlashCopy relationships
- Manage a Global Mirror session; add and remove volumes
- Manage a Global Mirror session; pause and resume, start and stop aGlobal Mirror session

24.5.2 Define paths

There is no change on how to define paths on the DS6000, or the DS8000, as compared to the ESS 800.

Note: For remote copy functions, only Fibre Channel links are supported on the DS6000.

Also note that when you utilize more than a single primary storage disk subsystem at the local site, you need to define paths between them for the Global Mirror session communication between the Master and the Subordinates. Also, you have to define the paths between the primary LSSs at the local site and the secondary LSSs at the remote site, so the Global Copy pairs can be established. Figure 24-8 on page 315 illustrates the needed paths for a Global Mirror environment.

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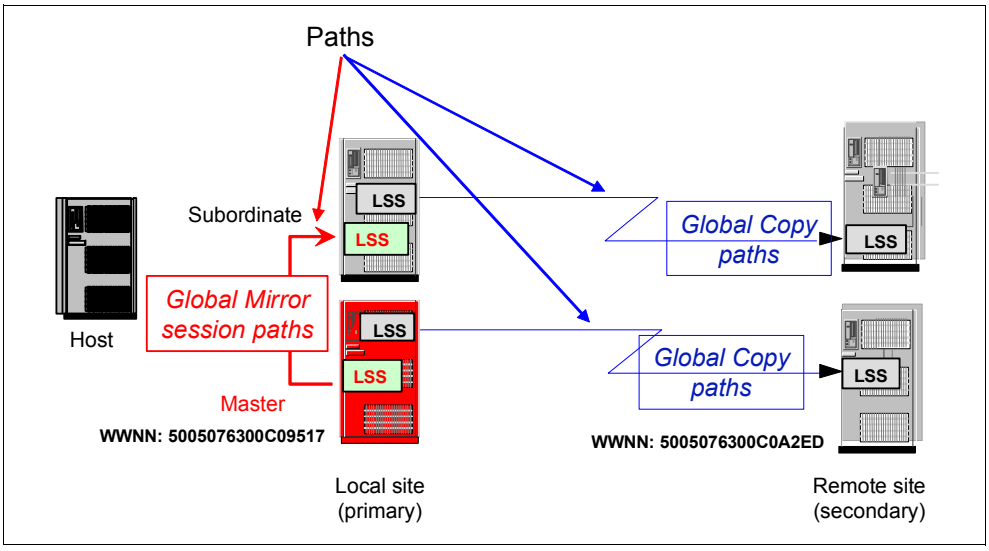

Figure 24-8 Define all needed paths for the Global Mirror environment through ICKDSF

Example 24-23 shows the JCL and command lines used to define paths between two storage disk subsystems. Note that an online volume cannot be referred via the ICKDSF UNIT parameter; ICKDSF assumes the volume to be offline when you use the UNIT parameter with a corresponding z/OS device number. On the other side, it is most likely that a Global Copy primary volume is online to the system from where you run the ICKDSF jobs. This requires that for each device you address through an ICKDSF command, you provide a JCL DD statement for this device; see Example 24-23.

Example 24-23 ICKDSF example to define paths

```
//* ------------------------------------------------------------- ***
//STEP01  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=RS7000,DISP=SHR
//SYSIN     DD *


 PPRCOPY DDNAME(DD01) ESTPATH   -
         PRI(X'7000' 22399)     -
         SEC(X'7800' 25941)     -
         LSS(X'00' X'00')       -
         FCPPATHS(X'000C000C'   -
                  X'008C008C')  -
         WWNN(5005076300C09517  -
              5005076300C0A2ED)

 PPRCOPY DDNAME(DD01)  QUERY  PATHS
/*
```

Note the extra parameter to identify the LSS; primary and secondary parameters contain the SSID besides the serial number. FCPPATHS contains the sending system adapter ID (SAID) and the receiving SAID. A WWNN is also required to identify the source and target disk subsystem.

It is recommended that you execute a query command to verify that the path definitions were successfully accomplished. It may happen that not all paths are successfully defined, and you want to find this out immediately.

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24.5.3 Establish Global Copy pairs

When you set up a Global Mirror environment, there is nothing particularly different concerning the Global Copy pairs. The command syntax used to establish Global Copy pairs with ICKDSF has no changes, whether used for Global Mirror setup or not. See Figure 24-9.

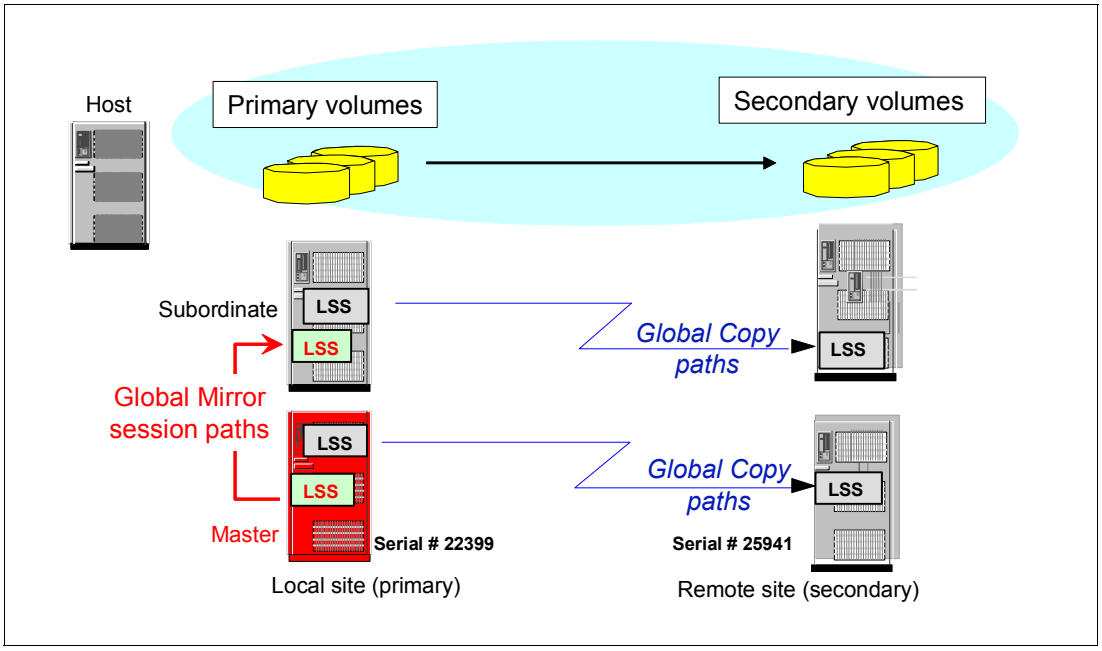

Figure 24-9 Establish Global Copy pairs

Example 24-24 shows the JCL and command lines used to create a Global Copy pair.

Example 24-24 Establish Global Copy pair through ICKDSF

```
//* ------------------------------------------------------------ ***
//STEP01  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=RS7000,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) ESTPAIR         -
         PRI(X'7000' 22399 X'00')     -
         SEC(X'7800' 25941 X'00')     -
         LSS(X'00' X'00')             -
         MODE(COPY) OPTION(XD)

 PPRCOPY DDNAME(DD01)  QUERY
/*
```

Note again the requirement for a JCL DD statement for the involved Global Copy primary volume. This may become a bit cumbersome when you intend to establish hundreds or even thousand of Global Copy pairs. You then need to add the same number of JCL DD statements and refer to each DD statement through the DDNAME parameter. The volume has to be online when you used the DDNAME approach, while with the UNIT parameter the volume has to be offline.

Again, the LSS parameter identifies the involved LSS. The primary (PRI) and secondary (SEC) parameters require positional parameters, with SSID in the first specification. The second parameter is the serial number of the corresponding storage disk subsystem, not in

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hex notation. In hex notation the third parameter refers to the channel connection address (CCA) of the corresponding device.

24.5.4 Establish FlashCopy relationships

The next step is to create the FlashCopy relationship between the B volume and the C volumes at the remote site; note in Figure 24-10 the particular attributes for FlashCopy because it is being used in a Global Mirror environment.

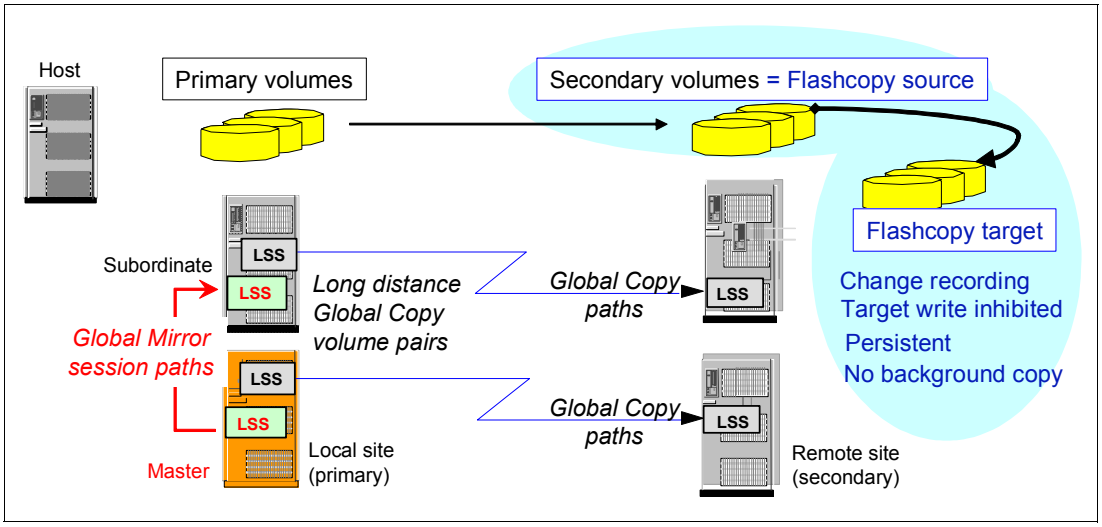

Figure 24-10 ICKDSF - create FlashCopy relationship for Global Mirror

Depending on whether you connect to the remote site or to the local site, the FlashCopy command is either directly issued to the remote storage disk subsystem or via an inband command. The inband command is targeted to the local primary volume, and provides addressing information for the FlashCopy source and target volumes at the remote site.

Example 24-25 shows an inband ICKDSF job example under the assumption that usually there is no host connection from the local site to the remote storage disk subsystem, which may reside on another continent.

Example 24-25 ICKDSF FlashCopy establish via an inband command

```
//* ------------------------------------------------------------- ***
//STEP01  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//SYSIN     DD *

 FLASHCPY   UNIT(7000) ESTABLISH                    -
            SOURCEVOL(X'00' X'00' X'7800' 25941)    -
            TARGETVOL(X'01' X'00' 7900)             -
            CHANGERCD(YES)                          -
            INHIBWRTS(YES)                          -
            MODE(NOCOPY)                            -
            TARGETCANCOMEONLINE(NO)

 FC         UNIT(7000) QUERY    -
            SRCVOL(X'00' X'00' X'7800' 25941
/*
```


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The ESTABLISH inband command has some complexity. UNIT points to the local primary volume. SOURCEVOL identifies the FlashCopy source volume at the remote site. Note this volume is also the Global Mirror secondary volume. TARGETVOL identifies the FlashCopy target volume. Both parameters require certain positional values. All parameters are in hex notation except the serial number in SOURCEVOL as the last positional parameter. In TARGETVOL, the last positional parameter is the z/OS device number of the FlashCopy target volume, which is also not specified in hex notation. For details refer to *Device Support Facility User's Guide and Reference Release 17*, SC35-0033.

The second FlashCopy command is a query of the FlashCopy pair that has just been established in the previous command (note that FLASHCOPY can be abbreviated, as well as SOURCEVOL). This second FlashCopy command is also an inband command, and is targeted to the FlashCopy source volume by the SRCVOL parameter, which is the same as in the previous FlashCopy command.

The job shown in Example 24-25 on page 317 refers to the A volume, which is the Global Copy primary volume, via the UNIT parameter. This requires the device on address 7000 to be offline. When the device is online to the system, and when this job executes, ICKDSF will return with an error message and fail the command.

Example 24-26 shows how to structure your commands and use abbreviated parameters. In the example the commands are targeted to the online volume and, therefore, require a corresponding JCL DD statement for the primary Global Copy volume.

Example 24-26 ICKDSF inband FlashCopy with abbreviated parameters

```
//* ------------------------------------------------------------- ***
//FCBTOC  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=XX2C00,DISP=SHR  local device
//SYSIN     DD *

  FC   DDNAME(DD01) ESTAB                       -
       SRCVOL       (X'0C',X'00',X'2C00' 03461)  -
       TGTVOL       (X'0E',X'00',3E00)           -
       CHRCD        (YES)                        -
       NOTGTWT      (YES)                        -
       MODE         (NOCOPY)

  FC   DDNAME(DD01) QUERY                       -
       SRCVOL       (X'0C',X'00',X'2C00' 03461)
/*
```

24.5.5 Define a Global Mirror session

In this step we create a session that will involve all LSSs that will participate in this Global Mirror environment. Each LSS that contributes with Global Copy primary volumes to this Global Mirror setup, requires to be defined in the session before adding volumes to the session. As Figure 24-11 on page 319 shows, the session number applies only to the LSS at the local site.

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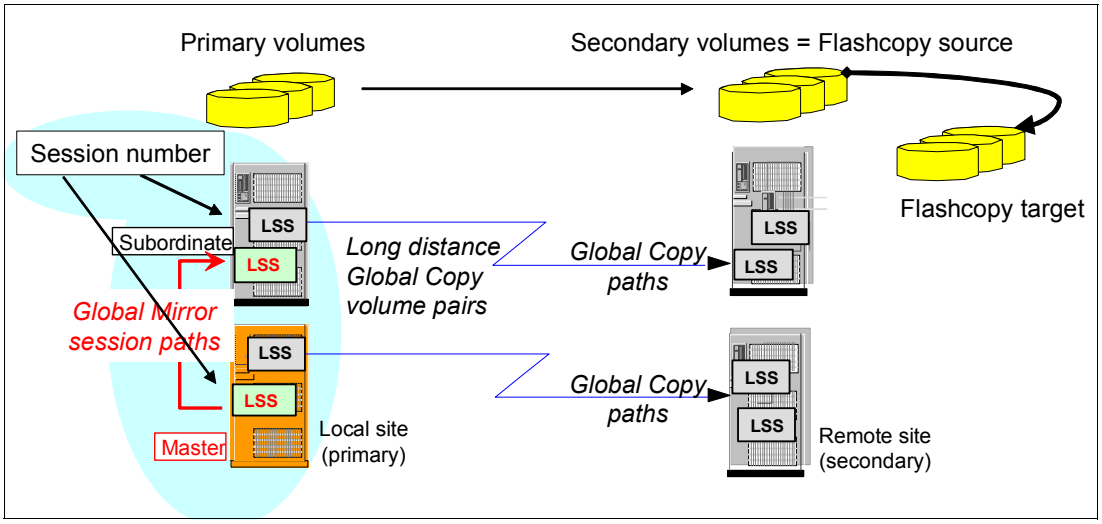

Figure 24-11 ICKDSF - define Global Mirror session

Example 24-27 shows an ICKDSF job that defines a Global Mirror session involving the LSS that volume RS7000 belongs to. Note that with this Global Mirror command, you do not need to define an LSS number, nor a CCA, nor the SSID.

Example 24-27 ICKDSF job to define a Global Mirror session to an LSS

```
//* ------------------------------------------------------------- ***
//STEP01  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=RS7000,DISP=SHR
//SYSIN     DD *

 PPRC DDNAME(DD01) DEFINESESSION   -
                   OPEN            -
                   SESSIONNO(001)

/*
```

Example 24-27 points again to an online volume by the DDNAME parameter. A session is created involving the corresponding LSS; it is session number 001 in this example.

24.5.6 Add volumes to a session

In this step we add Global Copy primary volumes to the Global Mirror session; see Figure 24-12 on page 320.

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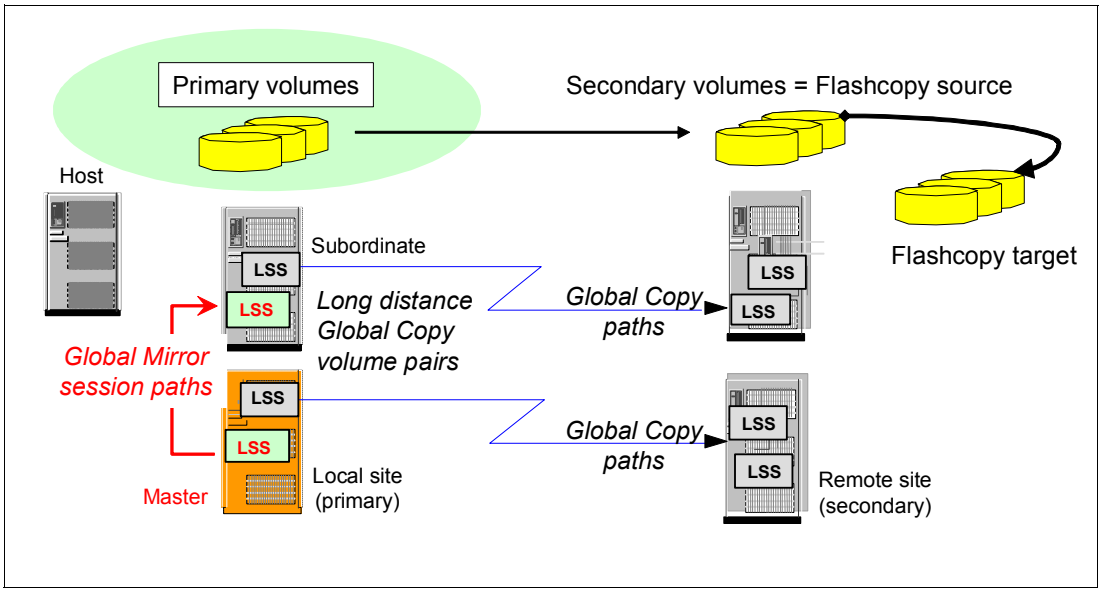

Figure 24-12 ICKDSF - populate a Global Mirror session with primary volumes

Example 24-28 shows the JCL and commands to add volumes to a Global Mirror session.

Example 24-28 Add volumes to session through ICKDSF

```
//* ------------------------------------------------------------ ***
//STEP01  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//SYSIN     DD *

 PPRC  UNIT(7000)     POPULATESESSION        -
                      JOIN SESSIONNO(001)    -
                      RANGE(NO) VOLCOUNT(1)  -
                      IVOLLIST((X'00'))

 PPRC  UNIT(7100)     POPULATESESSION        -
                      JOIN SESSIONNO(001)    -
                      RANGE(YES) VOLCOUNT(1) -
                      RVOLLIST(X'00',X'0F')


 PPRC  UNIT(7000)     QUERY                  -
                      SESSIONSDEVICES
/*
```

You indicate the Global Copy primary volumes that will become part of the Global Mirror session by either a list of CCA addresses, the IVOLLIST parameter, or a range of CCA addresses in the RVOLLIST parameter.

Let us look at more details of the VOLCOUNT parameter. Example 24-29 shows a case of multiple ranges of volumes specified in the PPRC POPULATESESSION command. Note that this command applies only to the LSS that is addressed by the UNIT parameter.

Example 24-29 Multiple volume ranges in ICKDSF Global Mirror command with RVOLLIST

```
RVOLLIST ((X'00',X'1F'),(X'30',X'3F')) VOLCNT(2)
```


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Note that the VOLCNT parameter counts the number of ranges you specify in the RVOLLIST parameter. In Example 24-29 the VOLCNT is 2 because RVOLLIST contains two ranges.

Instead of RVOLLIST, you can select dedicated volumes that are going to become a part of Global Mirror session through the IVOLLIST parameter. Volume count VOLCNT has a similar meaning with IVOLLIST as with RVOLLIST; see Example 24-30.

Example 24-30 Multiple volumes in ICKDSF Global Mirror command with IVOLLIST

```
IVOLLIST((X'00'),(X'02')) VOLCNT(2)
```

Note that each POPULATESESSION command addresses an LSS, and you need at least as many POPULATESESSION commands as LSSs are involved in a Global Mirror session.

24.5.7 Start Global Mirror

Once all Global Mirror components are defined and ready to be used, you start the Global Mirror session; see Figure 24-13.

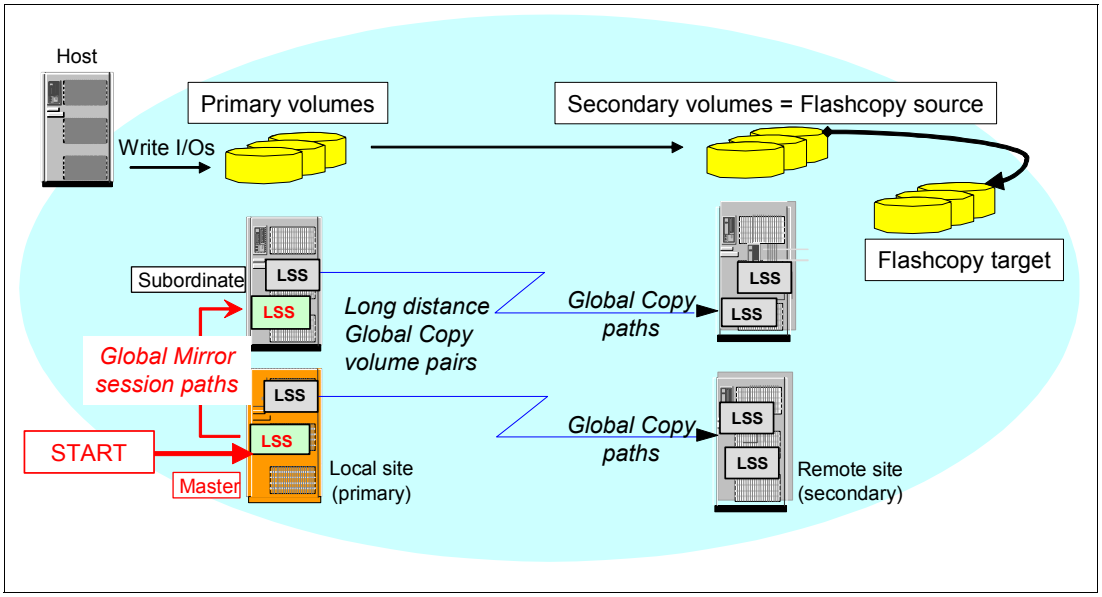

Figure 24-13 ICKDSF - start Global Mirror session

With the very first Global Mirror start command, you decide which LSS becomes the Master LSS. All further Global Mirror session commands have to go through the Master LSS.

Note that the Master LSS may also contain Global Copy primary volumes that are part of the Global Mirror session. Note also that you only need Global Mirror control paths between an LSS in the Master storage disk subsystem and an LSS in a Subordinate storage disk subsystem. Global Mirror communication within a storage disk subsystem is happening over internal communication paths.

Example 24-31 on page 322 shows how to start a Global Mirror session with ICKDSF. From now on, Global Mirror does Consistency Groups formation.

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Example 24-31 ICKDSF example to start a Global Mirror session

```
//* ------------------------------------------------------------ ***
//STEP01  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//SYSIN     DD *

 PPRC  UNIT(7000) STARTASYNCCOPY START             -
                  SESSIONNO(001)    -
                  MAXCOORDTIME(05)  -
                  MAXDRAINTIME(60)  -
                  CGINTERVALTIME(0)

 PPRC  UNIT(7000) QUERY ASYNCCOPY
/*
```

24.5.8 Query an active Global Mirror session

Figure 24-14 shows an ICKDSF command to query the devices and their session status. At the very moment when the query was done, a Consistency Group formation was going on.

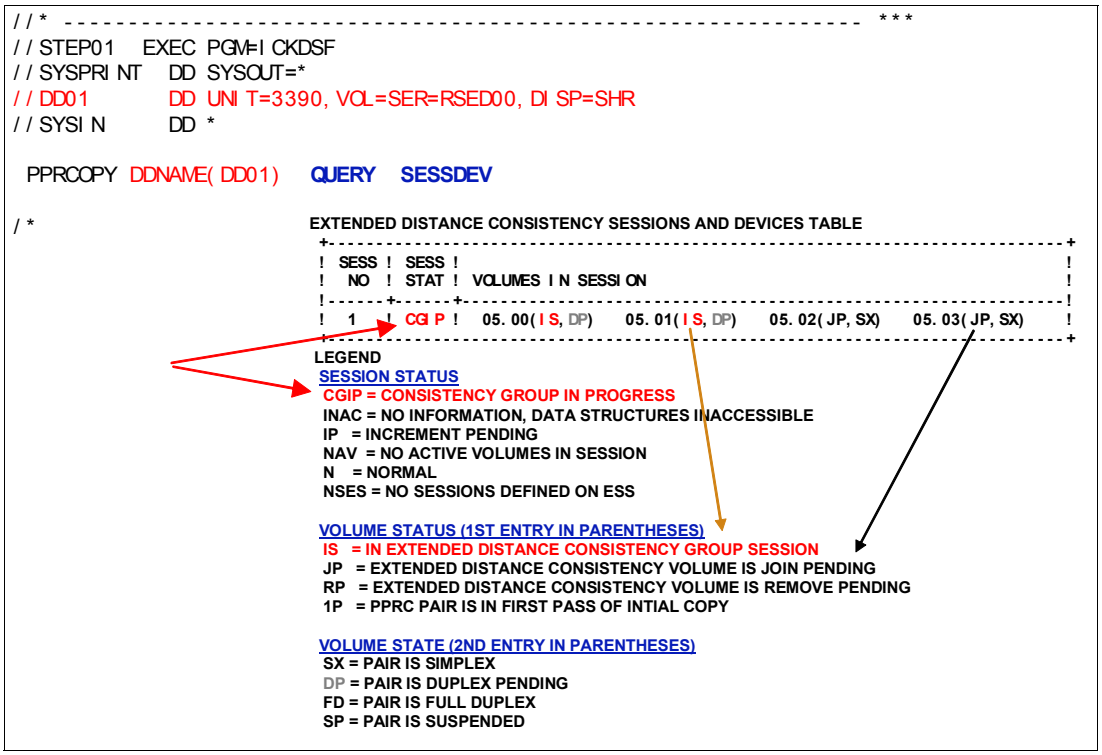
//* -- ***
//STEP01 EXEC PGM=ICKDSF
//SYSPRINT DD SYSOUT=*
//DD01 DD UNIT=3390,VOL=SER=RSED00,DISP=SHR
//SYSIN DD *
PPRCOPY DDNAME(DD01) QUERY SESSDEV
/*
EXTENDED DISTANCE CONSISTENCY SESSIONS AND DEVICES TABLE
! SESS NO ! SESS STAT ! VOLUMES IN SESSION
! 1 ! CGIP ! 05.00(IS, DP) 05.01(IS, DP) 05.02(JP, SX) 05.03(JP, SX)
LEGEND
SESSION STATUS
CGIP = CONSISTENCY GROUP IN PROGRESS
INAC = NO INFORMATION, DATA STRUCTURES INACCESSIBLE
IP = INCREMENT PENDING
NAV = NO ACTIVE VOLUMES IN SESSION
N = NORMAL
NSES = NO SESSIONS DEFINED ON ESS
VOLUME STATUS (1ST ENTRY IN PARENTHESES)
IS = IN EXTENDED DISTANCE CONSISTENCY GROUP SESSION
JP = EXTENDED DISTANCE CONSISTENCY VOLUME IS JOIN PENDING
RP = EXTENDED DISTANCE CONSISTENCY VOLUME IS REMOVE PENDING
1P = PPRC PAIR IS IN FIRST PASS OF INTIAL COPY
VOLUME STATE (2ND ENTRY IN PARENTHESES)
SX = PAIR IS SIMPLEX
DP = PAIR IS DUPLEX PENDING
FD = PAIR IS FULL DUPLEX
SP = PAIR IS SUSPENDED

Figure 24-14 ICKDSF - query devices in a Global Mirror session

The query also shows four volumes within the LSS indicated by DDNAME, that are also part of the Global Mirror session. The first two volumes are in session (IS). The next two volumes are defined to the session but they are in a join pending (JP) state, and they are not Global Copy primary volumes (simplex, SX). This means the volumes have been added to the session with the POPULATESESSION command, although these volumes are not Global Copy primary volumes. This is indicated by the SX code.

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```
//* ------------------------------------------------------------- ***
//STEP01   EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=RSED00,DISP=SHR     PPRC XD Primary
//SYSIN     DD *

 PPRCOPY DDNAME(DD01)    QUERY   ASYNCCOPY
/*

SESSION INFORMATION
CURRENT TIME = 2004.05.20.16:49:54
+-----------------------------------------------------------------------------------------------------------------------+
!    !     !       !       !       !          ! TOTAL #  !      !          ! TOTAL #  !                              !
!    !     !       !       !       !          ! GOOD CGS !      ! # FAILED  ! UNSUCCFL !                              !
!    !     !       !  MAX  !  MAX  !          !  FORMED  !      ! TRIES TO  ! TRIES TO !    THIS MASTER TO OTHER      !
!    !     !  CG   ! COORD !  CG   !  TIME    !  SINCE   ! %AGE ! FORM CG  ! FORM CG  !     SUBORDINATES DATA        !
!    !     ! INTVL ! INTVL ! DRAIN !  LAST    ! LAST IML ! GOOD ! SINCE    !  SINCE   !--------------------------!
!SESS!     ! TIME  ! TIME  ! TIME  ! GOOD CG  !    OR    ! CG   ! LAST GOOD ! LAST IML !MSTR/LSS!SUB/LSS!  SUBORD  !
! NO !STATE! (SEC) ! (MSEC)! (SEC) ! FORMED   ! FAILOVER ! FRMD ! CG FORMED !CR FAILOVR!SSID    !SSID   !   CUSN   !
!----+-----+-------+-------+-------+----------+---------+------+-----------+---------+--------+-------+----------!
!  1 !RUN  !   0   !   3   !  30   ! 05/20/04 !   3143  !  98  !    00     !    46   ! NO SUBORDINATES DEFINED  !
!    !     !       !       !       ! 16:49:52 !         !      !           !         !                            !
+-----------------------------------------------------------------------------------------------------------------------+

CONSISTENCY GROUP FAILURES REPORT
+-------------------------------------------------+
!      !          !            !     !       ! MASTER !
! SESS !  WHICH   !            !     ! ERROR ! STATE  !
!  NO  ! FAILURE !    CUSN    ! LSS ! REASON ! CODE   !
!------+---------+------------+-----+--------+--------!
!  1   !  FIRST  !   27310    !  05 !    FCC !    04  !
!      !---------+------------+-----+--------+--------!
!      !  PREV   !   27310    !  05 !    FC4 !    05  !
!      !---------+------------+-----+--------+--------!
!      !  MRCNT  !   27310    !  05 !    FC4 !    05  !
+-------------------------------------------------+
```

Partial output

Figure 24-15 ICKDSF - query session information and CG failure report

Figure 24-15 shows an ICKDSF query command of a Global Mirror session and its edited output. The Master LSS is pointed to by the DDNAME volume serial. This query command provides two reports:

- Under Session Information you find details on forming Consistency Groups. In the table you also find the Global Mirror session tunable variables that are active.
- The Consistency Group Failure Report provides information about why forming Consistency Groups failed. Example 24-32 provides the corresponding legend to understand the codes that are shown in this report.

Example 24-32 Legend to address ICKDSF Consistency Group FAILURE REPORT

```
LEGEND
   SESS NO
     UA   : UNABLE TO RETRIEVE INFORMATION, DATA STRUCTURES UNAVAILABLE. WAIT A FEW MINUTES
AND RETRY.

   WHICH FAILURE
     FIRST : FIRST Consistency Group FAILURE
     PREV  : PREVIOUS Consistency Group FAILURE
     M RCNT: MOST RECENT Consistency Group FAILURE

   LSS, ERROR REASON, OR MASTER STATE CODE
     FO/IM: INFORMATION UNAVAILABLE DUE TO FAILOVER OR IML
     N/A  : NOT AVAILABLE, PERHAPS DUE TO FAILOVER OR IML, OR NOT APPLICABLE

   ERROR REASON
     01  : ASYNCHRONOUS PPRC STRUCTURES CANNNOT BE ACCESSED
     02  : ASYNCHRONOUS PPRC COMMUNICATION PATH FAILURE
     03  : EXTENDED DISTANCE CONSISTENCY SESSION MEMBERS NOT IN CORRECT STATE
     04  : MAXIMUM Consistency Group DRAIN TIME EXCEEDED
```


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```
  400 : INVALID PARAMETER
  FYY : FORMAT 0X0F ERROR, WHERE YY IS THE REASON CODE
  7ZZZ: MICROCODE LOGIC ERROR - ZZZ DESCRIBES ERROR
  F005: TEMPORARILY UNAVAILABLE
  F01D: LONG BUSY

MASTER STATE
  01: PAUSE/TERMINATE ASYNCHRONOUS PPRC IN PROGRESS
  02: START/RESUME ASYNCHRONOUS PPRC IN PROGRESS
  03: ASYNCHRONOUS PPRC IS BETWEEN Consistency Group FORMATIONS
  04: XDC START INCREMENT IN PROGRESS
  05: XDC RUN IN PROGRESS
  06: DRAIN IN PROGRESS
  07: FLASHCOPY ESTABLISH WITH REVERTIBLE IN PROGRESS
  08: FLASHCOPY WITHDRAW WITH COMMIT IN PROGRESS
  09: XDC INCREMENT COMPLETE IN PROGRESS
  0A: FLASHCOPY WITHDRAW WITH REVERT IN PROGRESS
  0B: ASYNCHRONOUS PPRC IS PAUSED
  0C: ASYNCHRONOUS PPRC IS PERFORMING POST-Consistency Group TASKS
  0D: ASYNCHRONOUS PPRC IS FATAL
  0E: ASYNCHRONOUS PPRC IS COMPLETING ERROR RECOVERY
```

For more details, refer to *Device Support Facility User's Guide and Reference*, SC35-0033.

24.5.9 Remove a Global Mirror environment

The following sections discuss, in a step-by-step approach, how to remove a Global Mirror environment using ICKDSF. The sequence of steps followed in our example is the recommended one, although it is not a mandatory one. Still, it guarantees a clean and straightforward removal of the Global Mirror environment.

This is the recommended sequence for removing a Global Mirror environment:

1. Stop the Global Mirror session.
2. Remove the Global Copy primary volumes (A) from the Global Mirror session.
3. Un-define or remove the session from all involved primary LSSs.
4. Withdraw the FlashCopy relationship between the B and C volumes.
5. Delete the Global Copy volume pairs.
6. Remove the paths between local and remote LSSs, as well as the paths between the Master LSS and the Subordinate LSSs.

24.5.10 Stop the Global Mirror session

First you stop the Global Mirror session. This is a session command that you target to the Master LSS; see Example 24-33 on page 325.

Note that the Global Copy replication process still continues, but there are no FlashCopy operations any longer. This is because the FlashCopy operations were part of the process of Consistency Groups formation, but now we have asked to stop the session, thus to stop the Consistency Groups formation activity.

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Example 24-33 Stop Global Mirror session with ICKDSF

```
//* ------------------------------------------------------------- ***
//TERMSESS EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) TMASYNC     -
         SESSNO(001)              -
         TERMINATE                -
         MASTER
/*
```

Note also that an ongoing process to form a Consistency Group may not come to a successful end when you TERMINATE a session. In contrast to TERMINATE, a PAUSE would finish an ongoing Consistency Group formation before stopping further creation of Consistency Groups.

24.5.11 Remove volumes from Global Mirror

Next we remove the Global Copy primary volumes (A) from the Global Mirror session. Note that the session still exists; the previous TERMINATE parameter command just stopped the formation of Consistency Groups.

Example 24-34 Remove the A volumes from the Global Mirror session through ICKDSF

```
//* ------------------------------------------------------------- ***
//REMOVE  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) POPSESS         -
         REMOVE                       -
         SESSNO   (001)               -
         VOLCOUNT (1)                 -
         RANGE    (YES)               -
         RVOLLIST ((X'00',X'03'))
```

Example 24-34 is an ICKDSF example that removes four Global Copy primary volumes from session number 001. DDNAME points to the corresponding LSS. Note also that the REMOVE parameter command does not stop Global Copy from replicating data to the remote site.

The REMOVE parameter command is required for each LSS at the local site that contains volumes that belong to the Global Mirror session number 001.

24.5.12 Un-define the Global Mirror session

Now we delete the session and its session number from all involved LSSs at the local site.

Although the ICKDSF command in Example 24-35 specifies DEFINESESSION (or DEFSESS), the parameter CLOSE will in fact remove the Global Mirror session, and the corresponding session number, from the LSS pointed to by DDNAME. This command must be repeated for all LSSs that were involved in the Global Mirror session number 001.

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Example 24-35 Remove session from LSS with ICKDSF

```
//* ------------------------------------------------------------ ***
//CLOSESS EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) DEFSESS     -
         SESSNO(001)              -
         CLOSE
/*
```

Now, in the next steps, we will remove the FlashCopy relationships, and later we will delete the Global Copy pairs that belonged to the Global Mirror session we just deleted.

24.5.13 Withdraw FlashCopy relationships

Example 24-36 shows an ICKDSF example for removing the FlashCopy relationships between the B and C volumes.

Example 24-36 Withdraw FlashCopy relationships between B and C volumes with ICKDSF

```
//* ------------------------------------------------------------ ***
//* FLASHCOPY WITHDRAW (B -> C VOLUME RELATIONSHIP) inband       ***
//* ------------------------------------------------------------ ***
//*   SRCVOL (X'LSS' X'CCA' X'SSID' SERIAL#)                      ***
//*   TGTVOL (X'LSS' X'CCA' DEVICE#)                              ***
//* ------------------------------------------------------------ ***
//WITHDRW EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//DD02      DD UNIT=3390,VOL=SER=AA6001,DISP=SHR
//DD03      DD UNIT=3390,VOL=SER=AA6002,DISP=SHR
//DD04      DD UNIT=3390,VOL=SER=AA6003,DISP=SHR
//SYSIN     DD *

 FC  DDNAME(DD01)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'00',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'00',0003)        /* C VOLUME     */

 FC  DDNAME(DD02)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'01',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'01',0003)        /* C VOLUME     */

 FC  DDNAME(DD03)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'02',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'02',0003)        /* C VOLUME     */

 FC  DDNAME(DD04)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'03',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'03',0003)        /* C VOLUME     */
```

Note that we execute the FLASHCOPY WITHDRAW (or FC WD) command at the local site, to the Global Copy primary volumes. The primary volumes are identified by the JCL DD statement that is pointed to by the DDNAME parameter of the FC command; see Example 24-36. This is an inband FlashCopy command. Through the SRCVOL and the TGTVOL parameters, we identify the FlashCopy source and target volumes at the remote site. This command will end the FlashCopy relationship between the B and C volumes.

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24.5.14 Delete Global Copy pairs

Example 24-37 shows how to delete the Global Copy volume pairs.

Example 24-37 Delete Global Copy pairs with ICKDSF commands

```
//* ------------------------------------------------------------- ***
//DELPAIR EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//DD02      DD UNIT=3390,VOL=SER=AA6001,DISP=SHR
//DD03      DD UNIT=3390,VOL=SER=AA6002,DISP=SHR
//DD04      DD UNIT=3390,VOL=SER=AA6003,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'00') -
         SEC(X'0002' AAVCA X'00')

 PPRCOPY DDNAME(DD02) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'01') -
         SEC(X'0002' AAVCA X'01')

 PPRCOPY DDNAME(DD03) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'02') -
         SEC(X'0002' AAVCA X'02')

 PPRCOPY DDNAME(DD04) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'03') -
         SEC(X'0002' AAVCA X'03')
```

Note that ICKDSF explicitly refers to the source and target LSS. The PRI and SEC parameters identify the SSID, serial number, and CCA of the corresponding volumes.

24.5.15 Remove all paths

Finally, you remove the paths between the local and remote LSSs, as well as between the Master LSS and the Subordinates.

24.6 ANTRQST macro

The ANTRQST macro is part of the System Data Mover (SDM) component of DFSMSdfp™ and supports Global Mirror.

The support for Global Mirror includes the following request types:

- RSESSION

  This request type allows control of the Global Mirror sessions, and includes the following parameters: DEFINE, UNDEFINE, START, STOP, PAUSE, and RESUME.

- RVOLUME

  This request type is used to add (JOIN) or remove (REMOVE) Global Copy primary volumes to a Global Mirror session.

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- RQUERY

  There are several action parameters to determine what output information to obtain from a Global Mirror session. The API allows you to get more information out of a Global Mirror session than the respective TSO or ICKDSF commands. The ANTRQST macro allows you to direct the query output to a preallocated data set, with a logical record length or 120-byte fixed length.

The ANTRQST macro is not described in detail here. If you need more information about the Copy Services functions and how they are triggered through ANTRQST, refer to *z/OS DFSMS Advanced Copy Services*, SC35-0428. This manual also contains an Assembler sample program that starts a Global Mirror session.

24.7 DS Storage Manager GUI

Global Mirror can be managed through the DS Storage Manager-provided Web-based graphical user interface (GUI).

In this section we illustrate, with some examples, the use of the DS SM GUI to accomplish certain Global Mirror management activities. We are going to find out about the volumes that are in Global Mirror session number 01, and then pause and resume the session.

Note: The DS SM examples that we present in this section were run in a DS8000 HMC, but are basically similar to what you see in a DS6000 SMC when using the DS SM GUI.

Figure 24-16 shows the entry point to the Global Mirror real-time application.

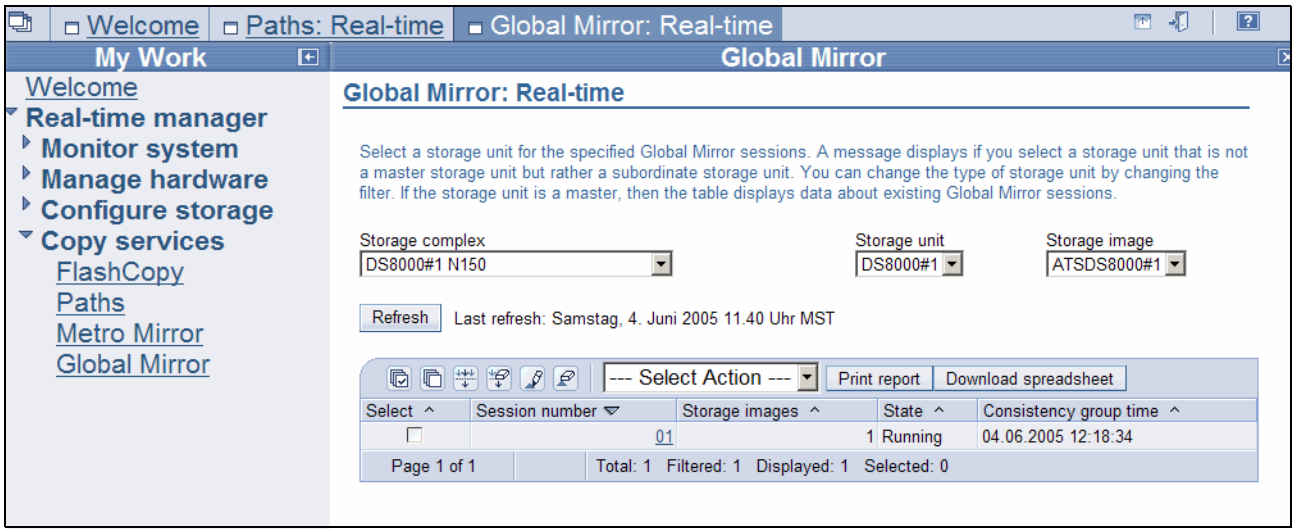

Figure 24-16 Select Global Mirror real-time application

From here you select session number 01 with the check box. From the action pull-down list you select an action.

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24.7.1 View Global Mirror volumes in session

From the panel in Figure 24-16 on page 328, we select the **View session volumes** from the pull-down list, as shown in Figure 24-17.

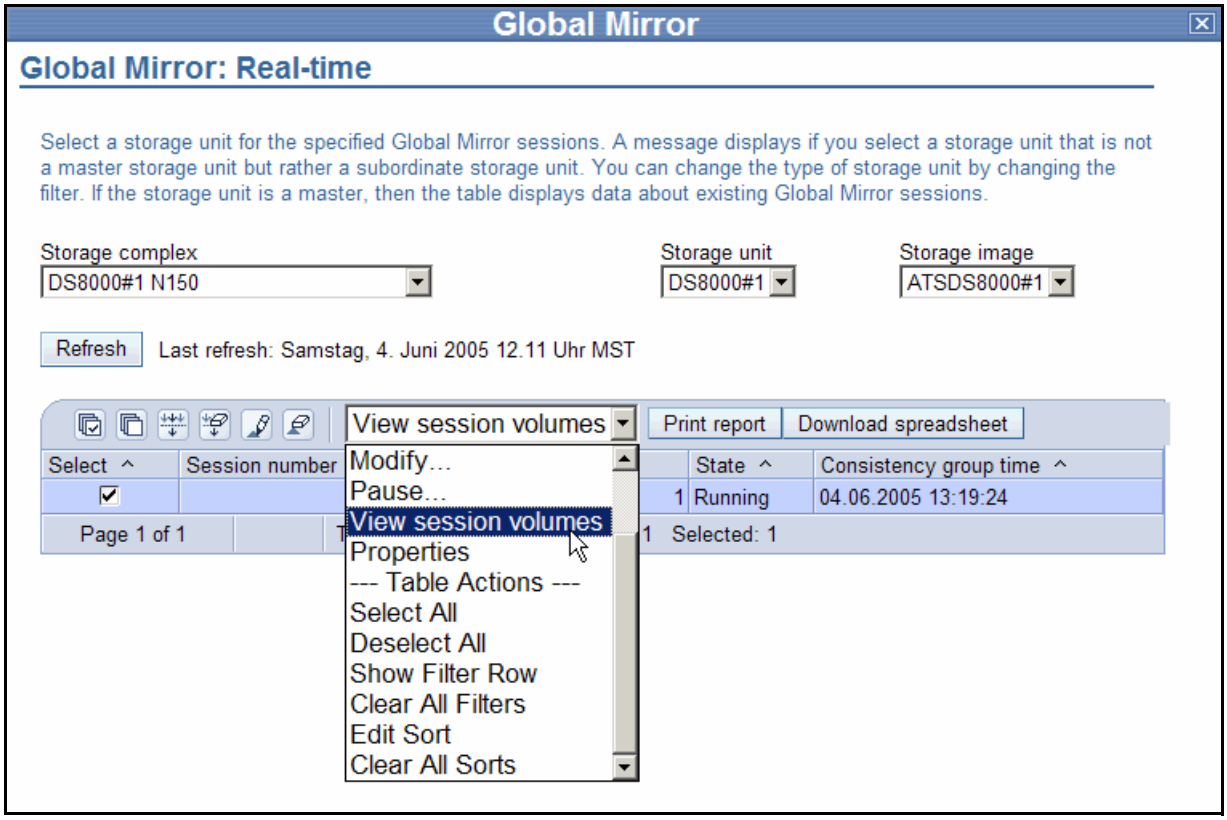
Global Mirror
Global Mirror: Real-time
Select a storage unit for the specified Global Mirror sessions. A message displays if you select a storage unit that is not a master storage unit but rather a subordinate storage unit. You can change the type of storage unit by changing the filter. If the storage unit is a master, then the table displays data about existing Global Mirror sessions.
Storage complex
DS8000#1 N150
Storage unit
DS8000#1
Storage image
ATSDS8000#1
Refresh
Last refresh: Samstag, 4. Juni 2005 12.11 Uhr MST
View session volumes
Print report
Download spreadsheet
Select
Session number
State
Consistency group time
1
Running
04.06.2005 13:19:24
Page 1 of 1
Selected: 1
Modify...
Pause...
View session volumes
Properties
--- Table Actions ---
Select All
Deselect All
Show Filter Row
Clear All Filters
Edit Sort
Clear All Sorts

Figure 24-17 View Global Mirror volumes in session1 - select action

The next panel, shown in Figure 24-18, provides the requested list of Global Copy primary volumes that are defined to session number 01.

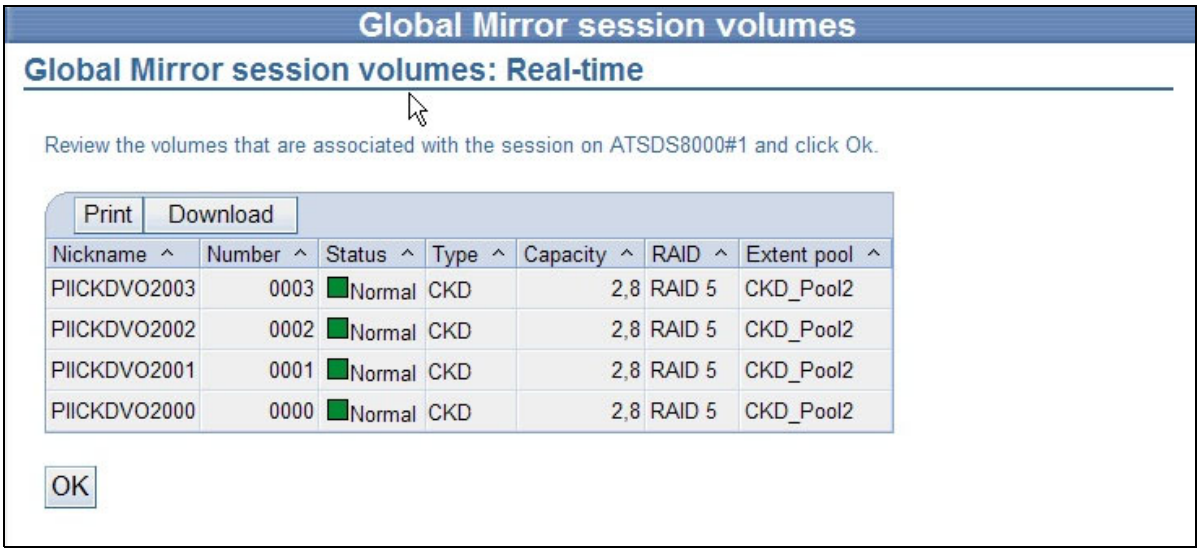

Figure 24-18 View Global Mirror volumes in session1 - volume list

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Figure 24-18 suggests you choose meaningful nicknames for the volumeswhen you define them to the DS6000. These nicknames indicate that the volumes belong to Extent Pool2, which is a CKD pool, and the corresponding z/OS device numbers are 2000+. The syntax of the nicknames is a bit limited and does, for example, not allow you to use numerics in the prefix part of the nickname when defined through the GUI.

24.7.2 Pause and resume Global Mirror

We are now going to pause Global Mirror session number 01, and then resume the session number again.

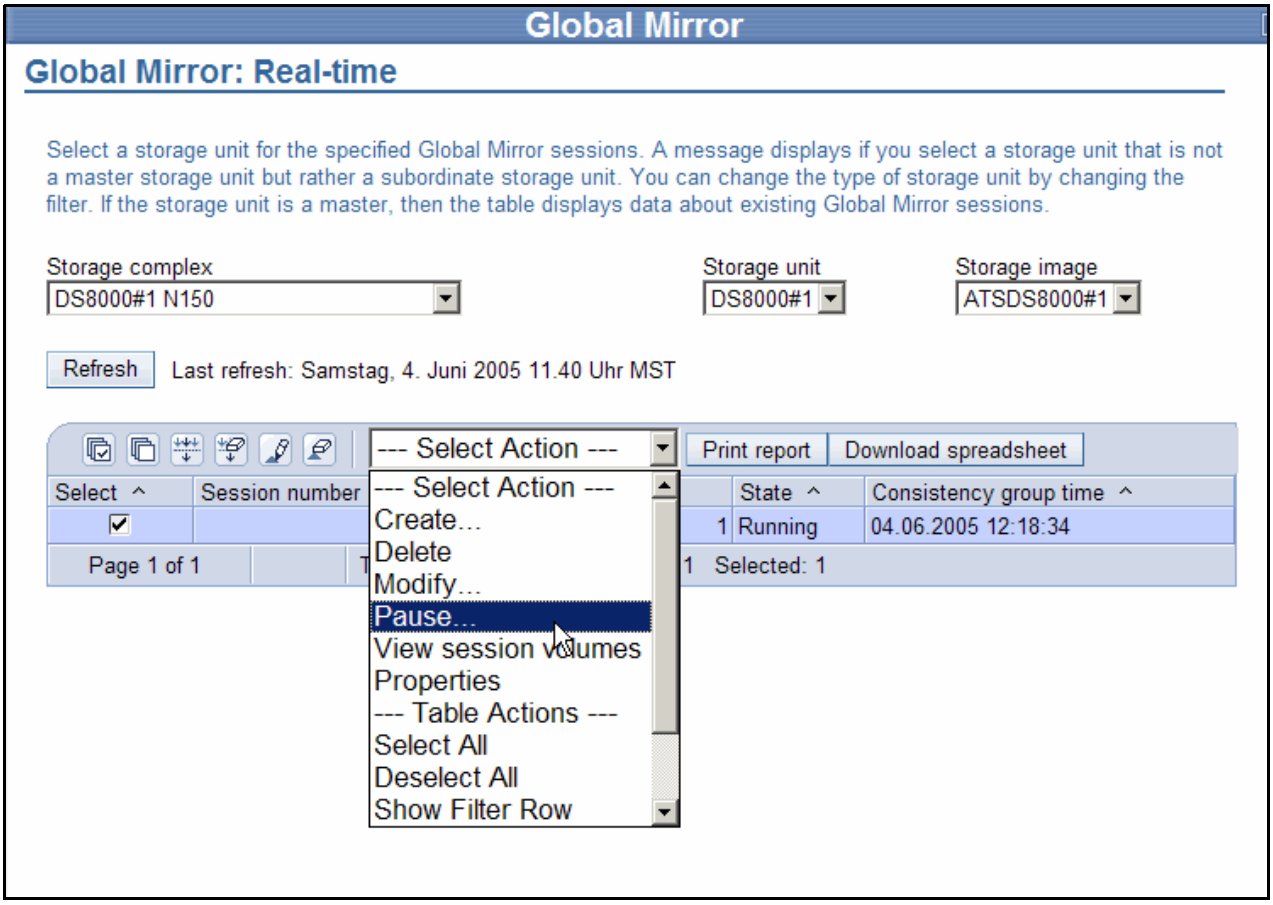
Global Mirror
Global Mirror: Real-time
Select a storage unit for the specified Global Mirror sessions. A message displays if you select a storage unit that is not a master storage unit but rather a subordinate storage unit. You can change the type of storage unit by changing the filter. If the storage unit is a master, then the table displays data about existing Global Mirror sessions.
Storage complex
DS8000#1 N150
Storage unit
DS8000#1
Storage image
ATSDS8000#1
Refresh
Last refresh: Samstag, 4. Juni 2005 11.40 Uhr MST
--- Select Action ---
Print report
Download spreadsheet
Select
Session number
State
Consistency group time
1
Running
04.06.2005 12:18:34
Page 1 of 1
1 Selected: 1
--- Select Action ---
Create...
Delete
Modify...
Pause...
View session volumes
Properties
--- Table Actions ---
Select All
Deselect All
Show Filter Row

Figure 24-19 Pause selected session number 1 through the GUI

Start again with the pull-down action list and from the Select Action pull-down list, select **Pause**; see Figure 24-19.

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Next you receive a confirmation panel as shown in Figure 24-20.

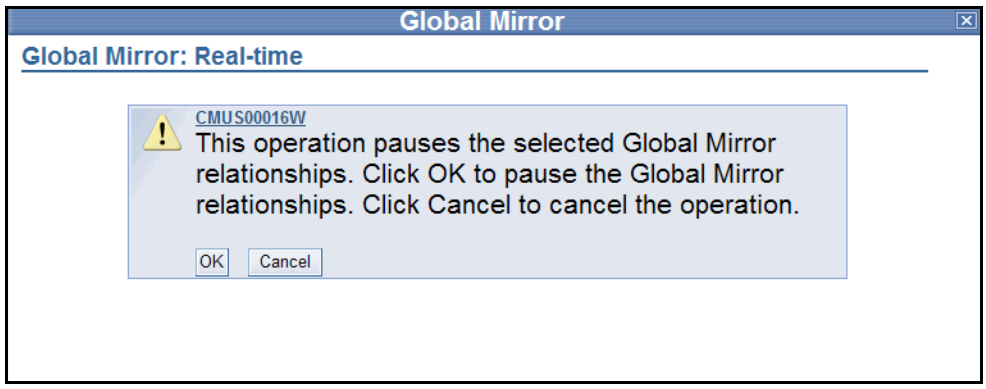
Global Mirror
Global Mirror: Real-time
CMUS00016W
This operation pauses the selected Global Mirror relationships. Click OK to pause the Global Mirror relationships. Click Cancel to cancel the operation.
OK
Cancel

Figure 24-20 Pause selected session number 1 - confirmation panel

Click **OK** and you receive the next panel; see Figure 24-21.

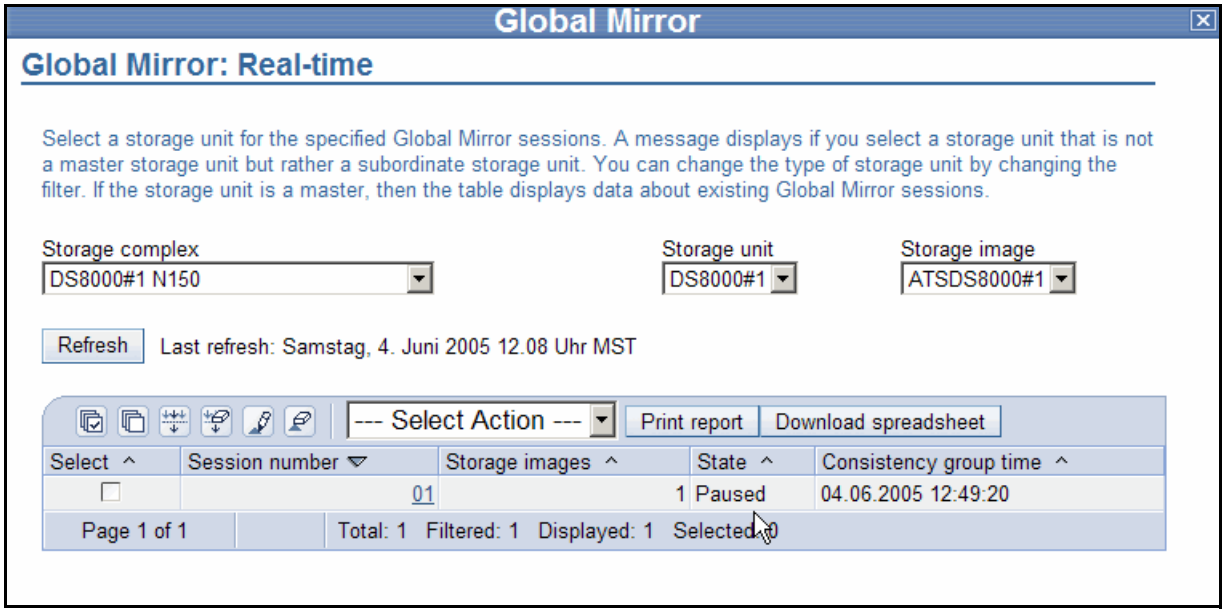
Global Mirror
Global Mirror: Real-time
Select a storage unit for the specified Global Mirror sessions. A message displays if you select a storage unit that is not a master storage unit but rather a subordinate storage unit. You can change the type of storage unit by changing the filter. If the storage unit is a master, then the table displays data about existing Global Mirror sessions.
Storage complex
DS8000#1 N150
Storage unit
DS8000#1
Storage image
ATSDS8000#1
Refresh
Last refresh: Samstag, 4. Juni 2005 12.08 Uhr MST
--- Select Action ---
Print report
Download spreadsheet
Select
Session number
Storage images
State
Consistency group time
01
1
Paused
04.06.2005 12:49:20
Page 1 of 1
Total: 1 Filtered: 1 Displayed: 1 Selected: 0

Figure 24-21 Session is paused

Figure 24-21 shows the result as well as the status information indicating that session number 01 is paused.

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We now resume the session. We select the corresponding action parameter, **Resume**, from the Select Action pull-down list; see Figure 24-22.

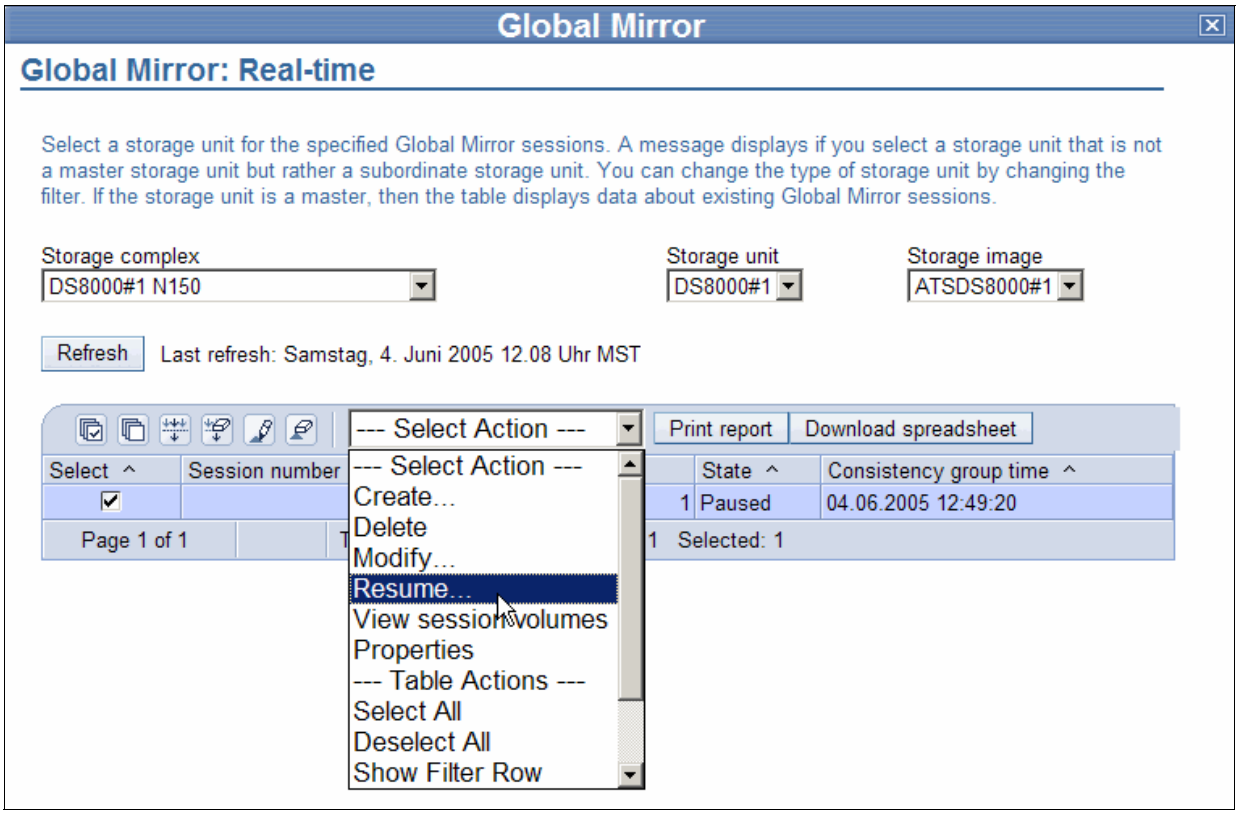

Figure 24-22 Resume paused session number 1 through the GUI

You receive another confirmation panel asking whether to continue with the resume operation; see Figure 24-23.

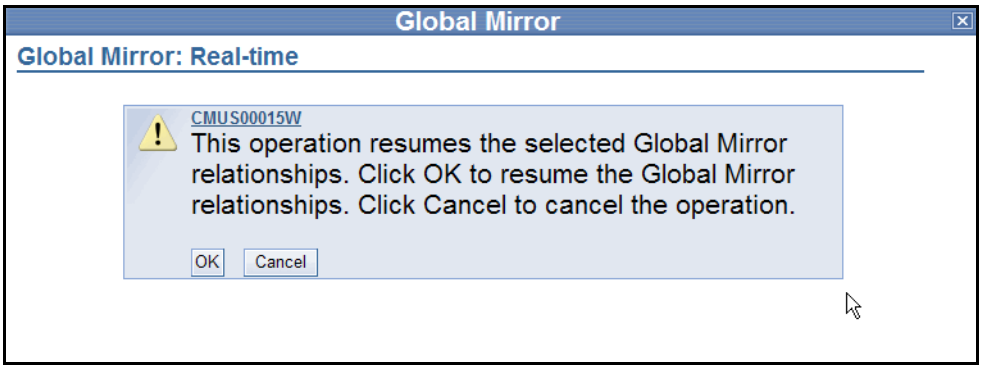
Global Mirror
Global Mirror: Real-time
CMUS00015W
This operation resumes the selected Global Mirror relationships. Click OK to resume the Global Mirror relationships. Click Cancel to cancel the operation.
OK
Cancel

Figure 24-23 Resume paused session number 1 through the GUI - confirmation panel

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We click **OK** and then receive the next panel; see Figure 24-24.

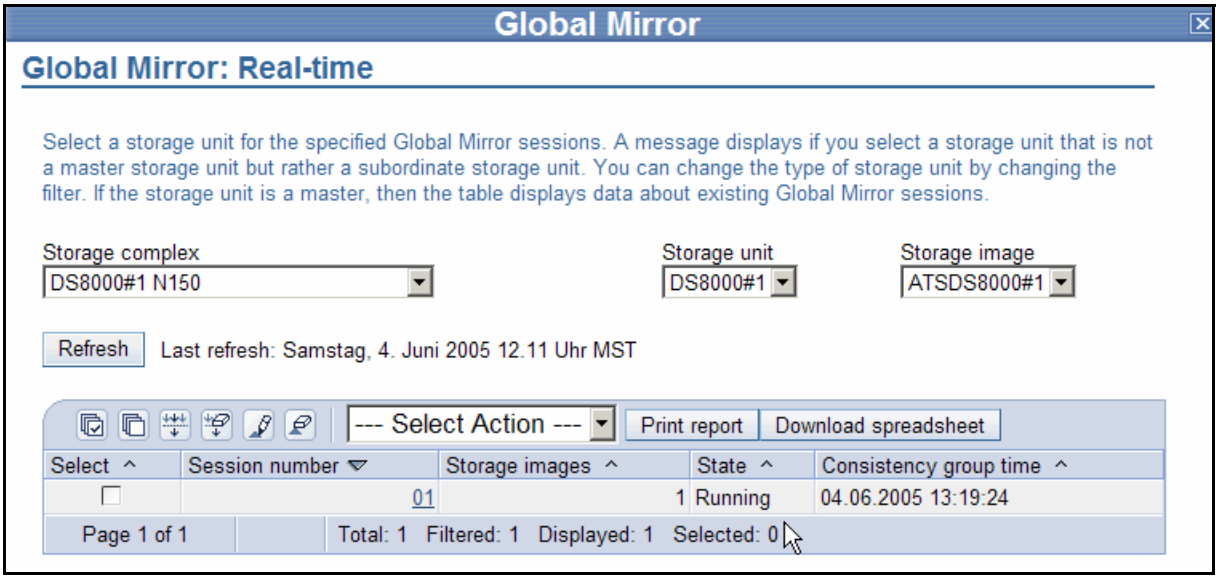
Global Mirror
Global Mirror: Real-time
Select a storage unit for the specified Global Mirror sessions. A message displays if you select a storage unit that is not a master storage unit but rather a subordinate storage unit. You can change the type of storage unit by changing the filter. If the storage unit is a master, then the table displays data about existing Global Mirror sessions.
Storage complex
DS8000#1 N150
Storage unit
DS8000#1
Storage image
ATSDS8000#1
Refresh
Last refresh: Samstag, 4. Juni 2005 12.11 Uhr MST
--- Select Action ---
Print report
Download spreadsheet
Select
Session number
Storage images
State
Consistency group time
01
1
Running
04.06.2005 13:19:24
Page 1 of 1
Total: 1 Filtered: 1 Displayed: 1 Selected: 0

Figure 24-24 Resume paused session number 1 through the GUI - session is running

The session is back and running.

There is a more extensive exercise based on the GUI in Chapter 26, “Global Mirror examples” on page 341.

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25

Global Mirror performance and scalability

This chapter discusses performance considerations for planning and configuring Global Mirror for DS6000. It also explains the potential impact that the three phases of Consistency Group formation might have on application write I/Os. Finally, it covers the distribution of B volumes and C volumes across different ranks, and how to provide extra care for very busy volumes.

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25.1 Performance aspects for Global Mirror

Global Mirror is basically comprised of Global Copy and FlashCopy, and it combines both functions to create a solution that provides consistent data at a distant site. Global Copy has, at most, only a minimal impact on the response time of an application write I/O to the Global Copy primary volumes.

In the Global Mirror environment, FlashCopy is used with the *nocopy* attribute. This implies that, for any write I/Os to the FlashCopy source volume, there will be additional internally triggered I/Os in the remote storage disk subsystem. These I/Os preserve the FlashCopy source volume tracks by making a copy to the FlashCopy target volume *before* the source tracks are updated. This happens every time within the interval in between two FlashCopy establish operations.

Note that the nocopy attribute does not start a background copy operation from source to target. It only maintains a set of FlashCopy bitmaps for the source and target volumes. These bitmaps are established the first time that the FlashCopy relationship is created with the nocopy attribute. Before a source track is modified between the creation of two Consistency Groups, the track is copied to the target volume to preserve the previous point-in-time copy. This includes updates to the corresponding bitmaps to reflect the new location of the track, which belongs to the point-in-time copy. Be aware that each Global Copy write to a secondary volume in the window of two adjacent Consistency Groups causes such a FlashCopy I/O operation.

For an application I/O within this context, there is also a Global Copy I/O when Global Copy replicates a track from the primary volume to the secondary volume. This implies an additional read I/O in the primary storage disk subsystem and a corresponding write I/O to the secondary storage disk subsystem. In a Global Mirror environment, the Global Copy secondary volume is also the FlashCopy source volume. This might have some effect in a very busy disk subsystem.

Figure 25-1 approximates what happens in between two Consistency Group creation events. The application write I/O completes immediately at the local site (1). Global Copy reads the modified track at the local site (2). Before the track gets updated on the B volume, the FlashCopy source track is preserved on the C volume because of the nocopy attribute. This is a read (3) and a write (4) which are done to preserve the source track writing it to the C volume. Finally, the track is updated on the B volume by another write (5). This is not necessarily the exact sequence of internal I/O events, but rather an approximation. There are optimization and consolidation effects that make the entire process more efficient.

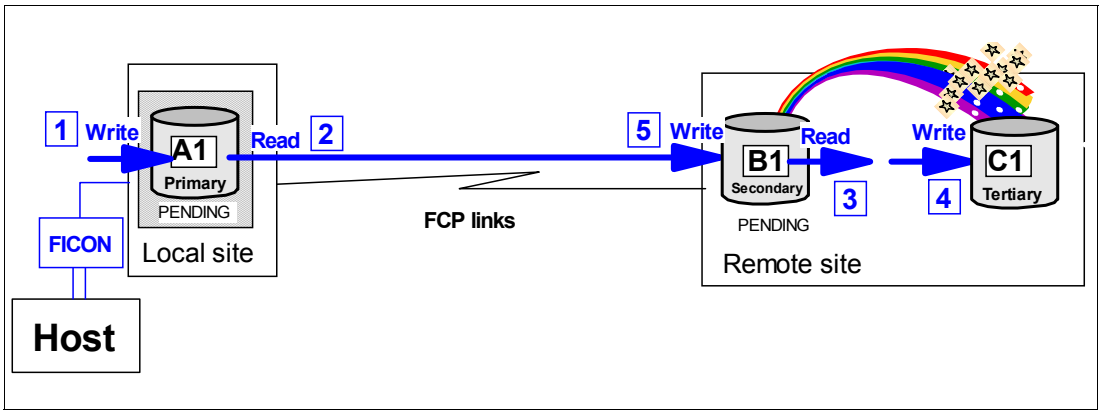

Figure 25-1 Application write I/O within two Consistency Group formation events

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There is potential impact on the Global Copy data replication operation, depending on whether persistent memory or non-volatile cache is over-committed in the secondary storage disk subsystem. In this situation, the FlashCopy source tracks might have to be preserved first to the FlashCopy target volume, before the Global Copy write completes. Usually, however, all writes are quick writes to cache and persistent memory.

A write I/O to the FlashCopy source volume also triggers the maintenance of a bitmap for the source volume, which is created when the FlashCopy volume pair is established with the *start change recording* attribute. The maintenance process means that you only have to replicate the changed recording bitmap to the corresponding bitmap for the target volume in the course of formation of a Consistency Group. See 22.4, “Consistency Groups” on page 260, for more information about this topic.

Note that this all applies only to write I/Os to the Global Mirror primary volumes.

25.2 Performance considerations at coordination time

When you look at the three phases that Global Mirror goes through to create a set of data consistent volumes at the secondary site, the first question that comes to mind is whether the coordination window imposes an impact to the application write I/O; see Figure 25-2.

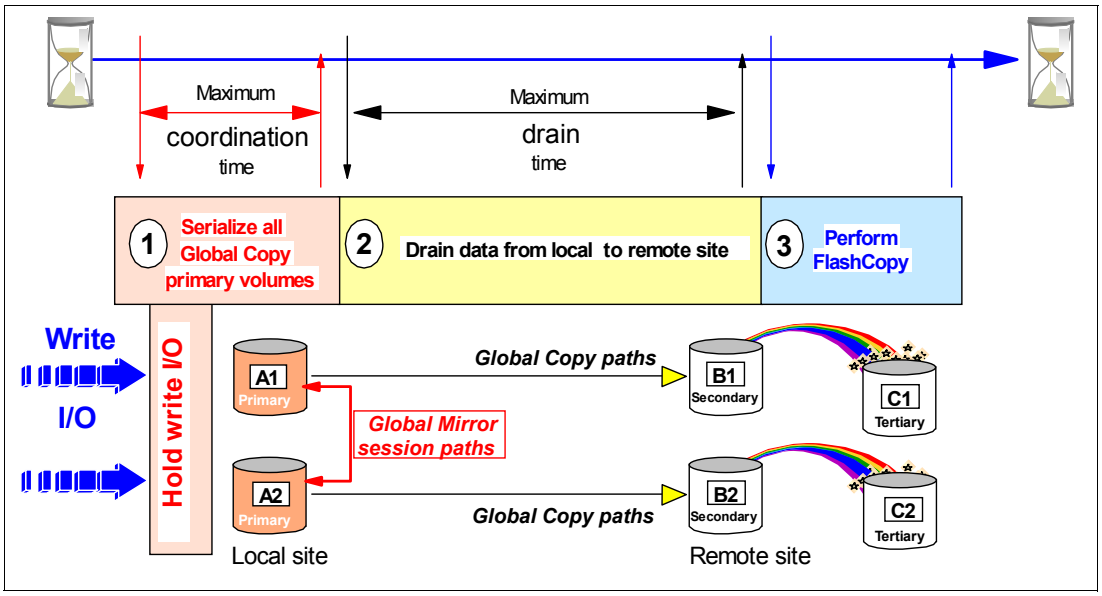

Figure 25-2 Coordination time - how it impacts application write I/Os

The *coordination time*, which you can limit by specifying a number of milliseconds, is the maximum impact to the write I/Os of an application, that you will allow when forming a Consistency Group. The intention is to keep this time window as small as possible. The default 50 ms might be a bit high in a transaction processing environment. A valid number could also be a very low number in the single digit range. The required communication between the master storage disk subsystem and subordinate storage disk subsystems is inband, over the Global Mirror session paths between the master and subordinates. This communication is highly optimized and allows you to minimize the potential application write I/O impact to 3 ms, for example. This communication is performed over FCP links. At least one FCP link is required between a Master storage disk subsystem and any potential Subordinate storage disk subsystems. For redundancy, we suggest using two FCP links.

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The following example addresses the impact of the coordination time when Consistency Group formation starts, and whether this impact has the potential to be significant or not.

Assume a total aggregated number of 5000 write I/Os over two primary storage disk subsystems, with 2500 write I/Os per second to each storage disk subsystem. Each write I/O takes 0.5 ms. You specified 3 ms maximum to coordinate between the master storage disk subsystem and its subordinate storage disk subsystem. Assume further that a Consistency Group is created every 3 seconds, which is a goal with the Consistency Group interval time of zero. To summarize:

- 5000 write I/Os
- 0.5 ms response time for each write I/O
- Maximum coordination time is 3 ms
- Every 3 seconds a Consistency Group is created

This is 5 I/Os for every millisecond or 15 I/Os within 3 ms. So each of these 15 write I/Os experience a 3 ms delay. This happens every 3 seconds. Then we observe an average response time delay of approximately:

(15 IOs * 0.003 sec) / 3*5000 IO/sec) = 0.000003 sec or 0.003 ms.

The response time increases on average from 0.5 ms to 0.503 ms. RMF is currently not capable of even showing such a small difference.

25.3 Consistency Group transmission

After the Consistency Group is established at the primary storage disk subsystems with the corresponding bitmaps within the coordination time window, all remaining data that is still in the out-of-sync bitmap is sent to the secondary storage disk subsystem with Global Copy.

This drain period can also be limited to replicate all remaining data from the primary to the secondary storage disk subsystem in a time limit set by the *maximum drain time*. The default is 30 seconds and is considered to be too small in a potentially write-intensive workload. A number in the range of 300 seconds to 600 seconds can be considered.

This replication process usually does not impact the application write I/O. There is a very low chance that the very same track in a Consistency Group might be updated before this track is replicated to the secondary site, while in this drain time period. When this unlikely event happens, the track is immediately replicated to the secondary storage disk subsystem, before the application write I/O modifies the original track. The application write I/O is going to experience a response time similar to that experienced if the I/O had been written to a Metro Mirror primary volume.

25.4 Remote storage disk subsystem configuration

There will be I/O skews and hot spots in the storage disk subsystems. This is true for the local and remote storage disk subsystems. For the local storage disk subsystems, you can consider a horizontal pooling approach, and spread each volume type across all ranks. Volume types are in this context, for example, DB2® database volumes, logging volumes, batch volumes, temporary volumes, and so forth. Your goal might be to have the same number of each volume type within each rank.

Through a one-to-one mapping from the local to the remote storage disk subsystem, you achieve the same configuration at the remote site for the B volumes and the C volumes.

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Figure 25-3 on page 339 proposes spreading the B and C volumes over different ranks at the remote storage disk subsystem.

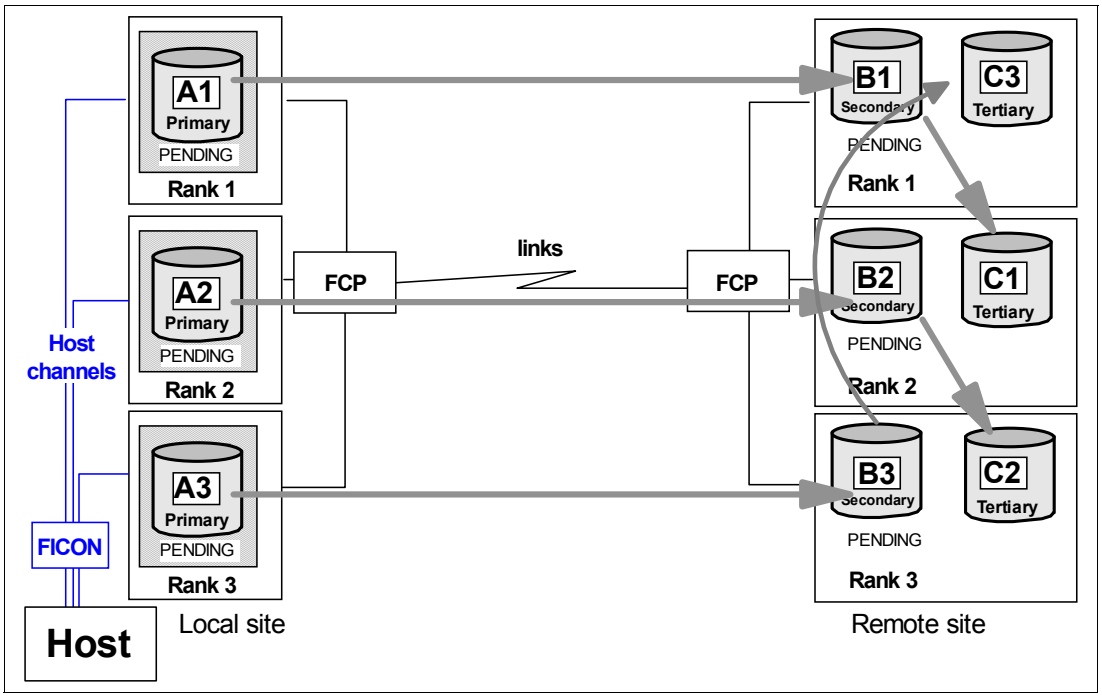

Figure 25-3 Remote disk subsystem - all ranks with equal numbers of volumes

The goal is to put the same number of each volume type into each rank. As volume type here, we refer to the B volumes and the C volumes of the Global Mirror configuration. To prevent an unbalanced configuration, spread busy volumes over multiple ranks. Otherwise, hot spots will be concentrated on single ranks when you put the B and C volumes on the very same rank. The authors recommend that you spread B and C volumes as shown in Figure 25-3.

Another aspect would be to focus on very busy volumes and keep these volumes on separate ranks away from all the other volumes.

With mixed disk drive capacities, and different speeds, consider spreading B volumes not only over the fast disks, but also over all ranks. Basically follow a similar approach to that in Figure 25-3. You can keep particular busy B volumes and C volumes on the faster disks.

Figure 25-4 on page 340 shows, in addition to the three Global Mirror volumes types, the D volumes, which can be created once in a while for test or other purposes. Here we suggest, as an alternative, a rank with larger and perhaps slower disks. The D volumes can be read from another host, and any other I/O to the D volumes does not impact the Global Mirror volumes in the other ranks. An option here might be to spread all B volumes across all ranks again, and also configure the same number of volumes in each rank.

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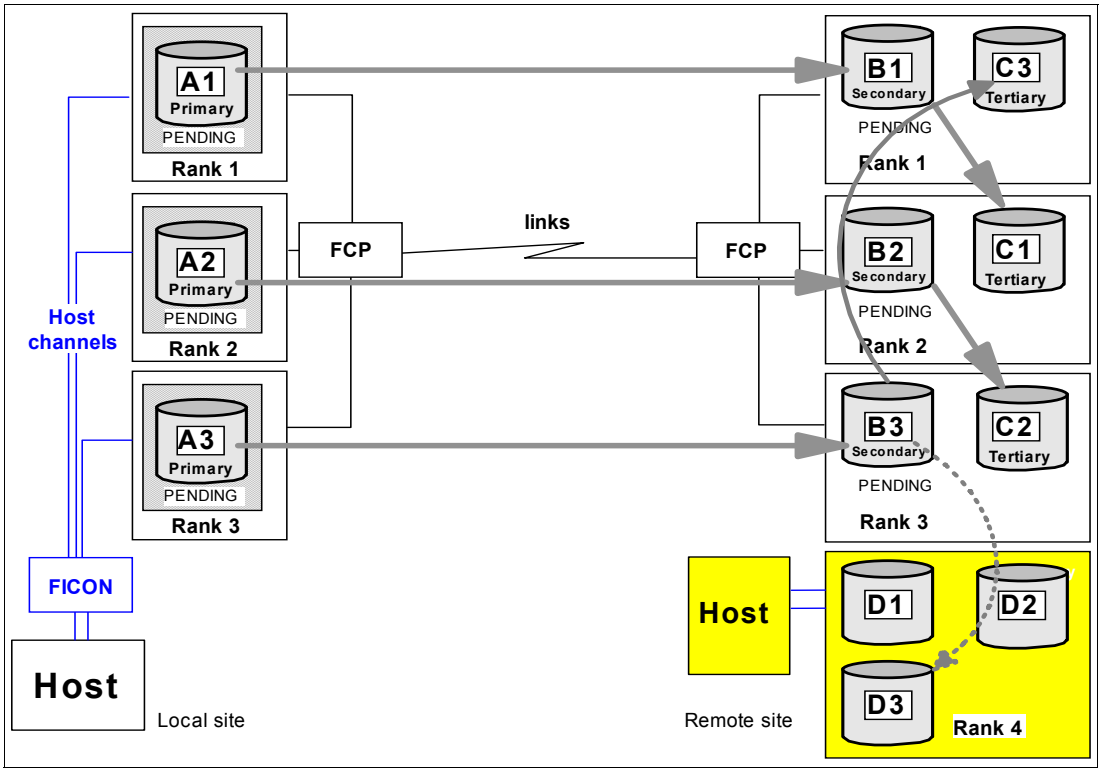

Figure 25-4 Remote storage disk subsystem with D volumes

You should still put the B and C volumes in different ranks. It is further recommended that you configure corresponding B and C volumes in such a way that these volumes have an affinity to the same server. It would also be ideal to have the B volumes connected to a different DA pair than the C volumes.

25.5 Growth within Global Mirror configurations

When you add a rather large number of volumes at once to an existing Global Mirror session, then the available resources for Global Copy within the affected ranks might be over-utilized or even monopolized by the initial copy pass. To avoid too much impact, consider adding many new volumes to an existing Global Mirror session in stages. If possible, and as a rough rule of thumb, add only a few volumes in a rank during application peak I/O periods. After the first initial copy is complete, add the next few volumes. Again, as a rule of thumb, plan for adding one or two volumes in a rank during peak I/O load for the first initial copy pass. If possible, then plan a massive add of new Global Copy volumes into an existing session during off-peak periods.

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26

Global Mirror examples

In this chapter we provide examples that illustrate how to set up and manage a Global Mirror environment, using the available interfaces: TSO commands, ICKDSF, DS SM GUI, and DS CLI. The examples show how to:

- Query Global Mirror sessions.
- Establish a Global Mirror environment (paths, pairs. session).
- Deal with a primary site failure and the subsequent recovery at the backup site. Also, the management of a planned outage is discussed.
- Remove a Global Mirror environment.

The information discussed in this chapter can be complemented with the following IBM publications:

- *z/OS DFSMS Advanced Copy Services*, SC35-0428
- *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922
- *Device Support Facility User's Guide and Reference*, SC35-0033

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26.1 Global Mirror examples - configuration

In order to illustrate the basic use of commands to manage a Global Mirror environment, the following examples are limited to a few volumes only to keep these examples as simple as possible and avoid confusing complexity.

Figure 26-1 shows the volumes with their device numbers and their SSIDs, which are used throughout most of the examples within this chapter. Some other configuration data may be used for the DS CLI examples, or examples based on ICKDSF.

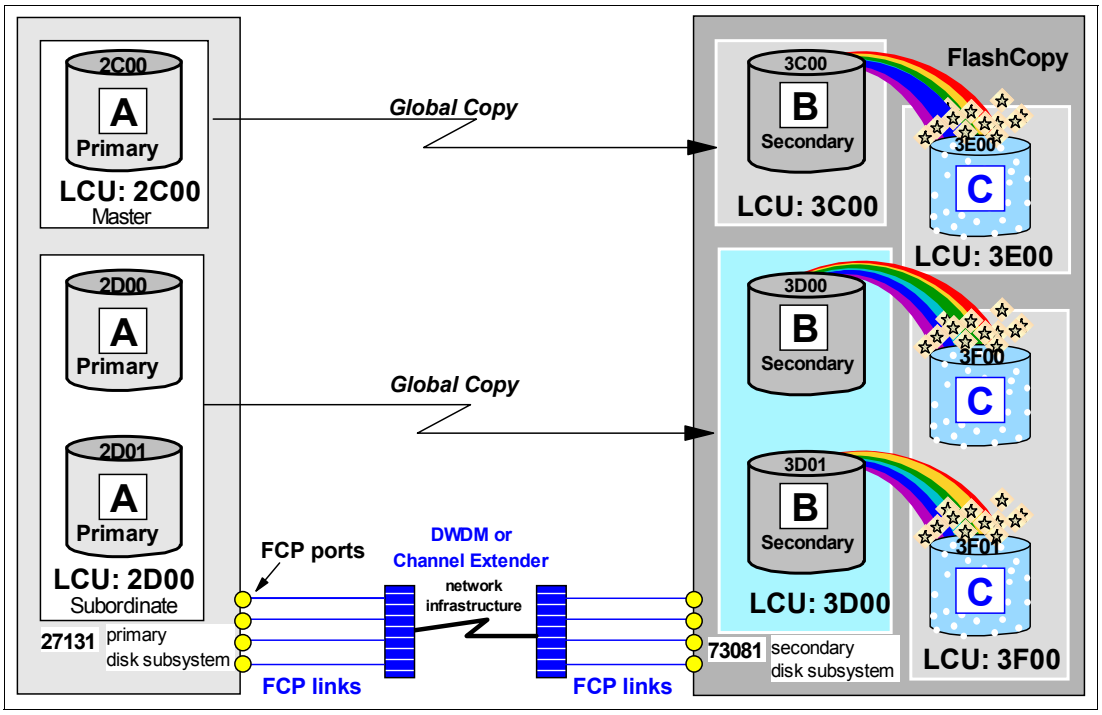

Figure 26-1 Global Mirror base configuration for the following examples

Note that one primary volume resides in SSID `2C00`, and two other primary volumes belong to SSID `2D00`, all of them in the primary storage disk subsystem `27131`. These primary volumes are also referred to as A volumes. The corresponding secondary volumes are in the respective SSIDs in the remote disk subsystem `73081`; so are the FlashCopy target volumes.

When a Global Mirror configuration is in normal operation, the Global Copy secondary volume is at the same time the FlashCopy source volume. These volumes are referred to as B volumes. The FlashCopy target volumes are referred to as C volumes.

26.2 Global Mirror query examples with TSO

The following examples describe how to set up a Global Mirror configuration using TSO commands. The first examples focus on the query capabilities. All the examples are based on the scenario illustrated in Figure 26-1.

26.2.1 Query a Global Mirror session

The RQUERY command provides information about a Global Mirror session. RQUERY has the following options:

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- DVCSTAT
- GMLSTAT
- GMPSTAT

The RQUERY command and its options have been explained in 24.3.8, “Query a Global Mirror session” on page 310.

26.2.2 Query Global Mirror volume status - DVCSTAT option

The DVCSTAT option returns information pertaining to the volumes in the LSS where VOLSER points to. Note that the specified VOLSER itself does not have to be a Global Mirror volume. You direct this command to an LSS that is part of a Global Mirror session.

Example 26-1 RQUERY TSO command with the DVCSTAT option and formatted output

```
RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(DVCSTAT)

RQUERY Output Volser(XX2C00) Action(DVCSTAT) Version(001)
SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
--   --  --  -------------------- ----------  ----------
01   0C  00  InSession            DplxPendng  Simplex
```

In Example 26-1 the query is targeted to an LSS with a Global Copy volume in session number `01`. The LSS is the one that has device `2C00` in it; see Figure 26-1 on page 342.

Through the VOLSER parameter, the next RQUERY points to the another LSS that is also involved in this Global Mirror session; see Example 26-2.

Example 26-2 RQUERY with DVCSTAT of the second LSS with Global Mirror volumes

```
RQUERY     SNBR(01) VOLSER(XX2D00) ACTION(DVCSTAT)

RQUERY Output Volser(XX2D00) Action(DVCSTAT) Version(001)
SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
--   --  --  -------------------- ----------  ----------
01   0D  00  InSession            DplxPendng  Simplex
     0D  01  InSession            DplxPendng  Simplex
```

All three volumes are in Global Mirror session number `01`. You may consider omitting the session number parameter SNBR. In this case RQUERY returns whatever session is currently active in the addressed LSS and its Global Mirror volumes.

26.2.3 Query Global Mirror session summary - GMLSTAT option

When used with the GMLSTAT parameter, the RQUERY command, pointing through the VOLSER parameter to the Global Mirror Master LSS, provides summary information about the volumes involved in the session.

When you address an LSS that is not the Global Mirror Master LSS, the GMLSTAT option does not return Global Mirror session information, as Example 26-3 on page 344 illustrates.

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Example 26-3 RQUERY GMLSTAT output when not addressing an LSS with an active session

```
RQUERY     SNBR(01) VOLSER(XX2D00) ACTION(GMLSTAT)

RQUERY Output Volser(XX2D00) Action(GMLSTAT) Version(001)
SNbr GMLStat    GoodCg   Pct CrnBadCG TotBadCG LastGoodCGSCntlClock
--   ---------- -------- --- -------- -------- --------------------
01   NoConfig
```

LSS 2D00 has an active Global Mirror volume but it is not the Master LSS. Therefore, RQUERY in Example 26-3 does not provide session summary information although both LSSs reside in the very same primary storage disk subsystem. Note that the decision of which LSS is the Master LSS, is made when the Global Mirror session is started.

Example 26-4 shows an example of the formatted output of the RQUERY command with the ACTION(GMLSTAT) parameter specified.

Example 26-4 Session summary as the Master LSS reports

```
RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(GMLSTAT)

RQUERY Output Volser(XX2C00) Action(GMLSTAT) Version(001)
SNbr GMLStat    GoodCg   Pct CrnBadCG TotBadCG LastGoodCGSCntlClock
--   ---------- -------- --- -------- -------- --------------------
01   Running    0000D0C1  99          00000005 19 May 2005 19:08:00
.
Master: Serial       SSID LSS   CGInt CGDrn CrdInt
        ------------ ---- --    ----- ----- -----
        000107527131 2C00 0C        0   600     5
.
BadCGrpFormation: When  Serial       SSID LSS Reason     Activity
                  ----- ------------ ---- --- ---------- ----------
                  Last  000107527131 2C00 0C  CmdRej FCC StrtIncr
                  Prev  000107527131 2C00 0C  CmdRej FCC StrtIncr
                  First 000107527131 2C00 0C  CmdRej FCC StrtIncr
```

This is the active Global Mirror session as was shown in Figure 26-1 on page 342. During these queries, a write workload was running on all three Global Mirror primary volumes.

26.2.4 Global Mirror session status for each LSS - GMPSTAT option

The ACTION(GMPSTAT) option returns Global Mirror session information with volume counts, and out-of-sync tracks information, related to the addressed LSS.

Example 26-5 RQUERY session status for LCU 2C00, LSS 0C

```
RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(GMPSTAT)

RQUERY Output Volser(XX2C00) Action(GMPSTAT) Version(001)
SNbr LSS GMPStatus  TotVol OOSVol OOSTrks
--   --  ---------- ------ ------ --------
01   0C  CGInPrgrs  1      0      00000000
```

Example 26-5 shows the formatted output with the session status details for LCU 2C00.

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26.2.5 Timing information

Creating consistency groups relies also on internal timing information. It is important to understand that the internal timer in the DS6000 is not synchronized with an external clock.

Example 26-6 shows an RQUERY command example with a TIME command just before the RQUERY command. The TSO TIME command displays the CPU based timer, which displays 10:09:32. Consistency Group drain time limit is 60 seconds or one minute. RQUERY displays the internal disk subsystem clock time with 14:37:59 as the time of the last good Consistency Group. Both timers are about 4 1/2 hours apart from each other. Even with a few failed attempts to form Consistency Groups, the disk subsystem clock time would be just a few minutes behind the CPU-based clock.

Example 26-6 Internal timer is not synchronized with external timer

```
TIME-10:09:32 AM. CPU-00:00:00 SERVICE-255 SESSION-00:00:00 JUNE 17,2005
READY
  RQUERY              VOLSER(AA601F) ACTION(GMLSTAT)
RQUERY Output Volser(AA601F) Action(GMLSTAT) Version(001)
SNbr GMLStat    GoodCg   Pct CrnBadCG TotBadCG LastGoodCGSCntlClock
--   ---------- -------- --- -------- -------- -------------------
01   Running    00000125  98 00000003 00000005 17 Jun 2005 14:37:59
.                                                                  .
Master: Serial       SSID LSS   CGInt CGDrn CrdInt
        ------------ ---- --    ----- ----- -----
        0002013AAGXA 2060 00       15    60     5
.                                                                  .
BadCGrpFormation: When  Serial       SSID LSS Reason     Activity
                  ----- ------------ ---- --- ---------- ----------
                  Last  0002013AAGXA ???? FF  DrTimeExcd DrnInPrg
                  Prev  0002013AAGXA ???? FF  DrTimeExcd DrnInPrg
                  First 0002013AAGXA 2060 00  CmdRej FC4 RunInPrg
READY
```

Note that you cannot rely on the internal disk subsystem clock time information as an absolute wall clock timing type. You may set the internal disk subsystem clock time with the help of an IBM customer engineer as close to the actual wall clock as possible.

26.3 Set up the Global Mirror environment using TSO

The following sequence of examples shows how to set up a Global Mirror environment using TSO commands. Most steps to create a Global Mirror environment can be done in any order. Still we recommend the following order:

1. Establish all necessary paths between the Global Copy primary LSSs and their corresponding secondary LSSs. Here also, you may establish paths at the local site, between the Master and any Subordinate storage disk subsystem LSSs, that will participate in the Global Mirror session. When there is only one primary storage disk subsystem involved, you do not need to define paths between the primary LSSs. In this case, the communication between Master and Subordinate LSSs within the storage disk subsystem is done internally.
2. Establish the Global Copy pairs between the A and B volumes. For this you use the MODE(COPY) parameter option. You may wait until the first initial copy phase is complete before continuing to the next step.
3. Establish FlashCopy relationships between the B and C volumes. Use the MODE(ASYNC) parameter option with the corresponding TSO FCESTABL command.

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Note: If you still have not defined the paths between the Master LSS and the Subordinate storage disk subsystem LSSs, then this is the time to do that before you continue on.

4. Define the Global Mirror session and create a session ID between 1 and 255. You define this session ID to the LSS that will become the Master, as well as to the LSSs in the Subordinate storage disk subsystems that are going to participate in this session. Still the Master LSS has not yet been appointed, which happens later when you start the session.
5. Populate the session with the Global Copy primary volumes (A). It is recommended that the Global Copy primary volumes be added to the session once they have completed their initial copy phase, also referred to as the “first pass.”
6. Start the session. This command actually defines the Master LSS. All further session commands have to go through this LSS. You may also specify with the start command the Global Mirror tuning parameters: maximum drain time, maximum coordination time, and Consistency Group interval time.

Volumes can be added to the session at any time after the session number is defined to the LSS where the volumes reside. Once the session is started, volumes can be added to the session or can be removed from the session at any time.

Note: You only add Global Copy primary volumes to a Global Mirror session.

Volumes may be added to a session in any state: simplex, pending, duplex, or suspended. Volumes that have not completed their initial copy phase stay in a *join pending* state until the first pass is complete. If a newly added volume to a session is a primary suspended volume, the first attempt to form a Consistency Group will fail. It is recommended to add only Global Copy primary volumes that completed their initial copy phase.

When you plan to add a new Subordinate storage disk subsystem to an active session, you have to stop the session first. Then add the new Subordinate storage disk subsystem and start the session again with the updated RSESSION command, which then also contains the new Subordinate storage disk subsystem.

When you add a new LSS to an active Global Mirror session, and this LSS belongs to a storage disk subsystem that already has another LSS which belongs to the session, you may just add the new LSS to the session without stop and start of the session. This is true for either the Master storage disk subsystem or for a Subordinate disk subsystem.

26.3.1 Define paths

First you define paths from A to B; see Example 26-7 on page 347. These are the paths that will be used for data transmission between the Global Copy pairs.

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Example 26-7 Define paths for Global Copy from A to B

```
//* ---------------------------- TSO ----------------------------- ***
//* ESTABLISH PATH(S) for Global Copy pairs                        ***
//* ---------------------------------------------------------------- ***
//EPATHS  EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

   CQUERY    DEVN (X'2C00') PATHS
   CESTPATH  DEVN (X'2C00')                          +
             PRIM (X'2C00' 5005076303FFC228  X'0C') +
             SEC  (X'3C00' 5005076303FFC422  X'0C') +
             LINK (X'00300030' X'01300130'          +
                   X'02300230' X'03310330') CGROUP(NO)
   CQUERY    DEVN (X'2C00') PATHS

   CQUERY    DEVN (X'2D00') PATHS
   CESTPATH  DEVN (X'2D00')                          +
             PRIM (X'2D00' 5005076303FFC228  X'0D') +
             SEC  (X'3D00' 5005076303FFC422  X'0D') +
             LINK (X'00300030' X'01300130'          +
                   X'02300230' X'03310330') CGROUP(NO)
   CQUERY    DEVN (X'2D00') PATHS
```

Verify, using query commands, that all paths have been defined and are operational. In our case, even though the previous path definition commands had completed successfully, a subsequent CQUERY reveals that there is a problem with one of the paths; see Example 26-8.

Example 26-8 Verify successful path creation

```
*************** PPRC REMOTE COPY CQUERY - PATHS ********************
* PRIMARY UNIT: SERIAL#= 000000027131 SSID= 2C00 SS= 2107 LSS= 0C  *
*              FIRST        SECOND         THIRD         FOURTH    *
*            SECONDARY     SECONDARY     SECONDARY     SECONDARY   *
*SERIAL NO: 000000073081  ............  ............  ............ *
* SSID LSS:   3C00 0C       .......       .......       .......    *
*    PATHS:      4             0             0             0       *
*           PFCA SFCA S*  SAID DEST S*  SAID DEST S*  SAID DEST S* *
*           --------- --  --------- --  --------- --  --------- -- *
*        1: 0030 0030 13  ---- ---- 00  ---- ---- 00  ---- ---- 00 *
*        2: 0130 0130 13  ---- ---- 00  ---- ---- 00  ---- ---- 00 *
*        3: 0230 0230 13  ---- ---- 00  ---- ---- 00  ---- ---- 00 *
*        4: 0331 0330 14  ---- ---- 00  ---- ---- 00  ---- ---- 00 *
*  SUBSYSTEM         WWNN                   LIC LEVEL              *
* ------------  ----------------           -----------            *
* PRIMARY....  5005076303FFC228            5.0.03.0097            *
* SECONDARY.1  5005076303FFC422                                   *
*                                                                 *
* S* = PATH STATUS:                                               *
* 00=NO PATH          01=ESTABLISHED ESCON   02=INIT FAILED       *
* 03=TIME OUT         04=NO RESOURCES AT PRI 05=NO RESOURCES AT SEC*
* 06=SERIAL# MISMATCH 07=SEC SSID MISMATCH   08=ESCON LINK OFFLINE *
* 09=ESTABLISH RETRY  0A=PATH ACTIVE TO HOST 0B=PATH TO SAME CLUSTR*
* 10=CONFIG ERROR     FF=UNABLE TO DETERMINE                      *
* 13=ESTABL FIBRE PTH 14=FIBRE PATH DOWN     15=FIBRE RETRY EXCEED *
* 16=SEC ADPTR INCPBL 17=SEC ADPTR UNAVAIL   18=FIBRE LOGIN EXCEED *
*******************************************************************
```


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You may also consider defining paths in the reverse direction. After a site failover and before you return to the local site it may be necessary to resynchronize the volumes from the remote site to the local site. This requires paths from the remote site to the local site. In contrast to ESCON, FCP links allow the definition of paths in either direction over the very same link.

26.3.2 Establish Global Copy volume pairs

Create Global Copy pairs as the next step. TSO requires one PPRC CESTPAIR command for each Global Copy pair to be established; see Example 26-9.

In the example, note that the ONLINSEC parameter is YES. It is recommended to leave this parameter with its default value NO, which will avoid the situation where an active volume is overridden by accident. With a value of NO, when the potential Global Copy secondary volume is online to any system, the establish pair command will fail. When you specify YES, the establish will happen independently of whether the potential secondary volume is online or offline.

Example 26-9 Establish Global Copy volume pairs

```
//* ---------------------------- TSO ------------------------------ ***
//* ESTABLISH PPRC-XD PAIR(S)                                        ***
//* ---------------------------------------------------------------- ***
//EPAIR   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'2C00')                    +
           PRIM (X'2C00' 27131 X'00' X'0C')  +
           SEC  (X'3C00' 73081 X'00' X'0C')  +
           ONLINSEC(YES) MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)    MODE(COPY)

 CESTPAIR  DEVN (X'2D00')                    +
           PRIM (X'2D00' 27131 X'00' X'0D')  +
           SEC  (X'3D00' 73081 X'00' X'0D')  +
           ONLINSEC(YES) MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)    MODE(COPY)
 CESTPAIR  DEVN (X'2D01')                    +
           PRIM (X'2D00' 27131 X'01' X'0D')  +
           SEC  (X'3D00' 73081 X'01' X'0D')  +
           ONLINSEC(YES) MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)    MODE(COPY)

 CQUERY    DEVN (X'2C00')
 CQUERY    DEVN (X'2D00')
CQUERY   DEVN (X'2D01')
```

Make sure the establish commands complete successfully and their initial copy phase starts. For this you use a CQUERY command; see Example 26-10 on page 349.

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Example 26-10 Verify that the establish Global Copy succeeded

```
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 2D00  PRIMARY..  PENDING.XD   ACTIVE..   2D00 00 0D   3D00 00 0D *
*       CRIT(NO).......       CGRPLB(NO). 000000027131 000000073081*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  ------------------                       *
*   4   0030 0030   13    PATH ESTABLISHED...                      *
*       0130 0130   13    PATH ESTABLISHED...                      *
*       0230 0230   13    PATH ESTABLISHED...                      *
*       0331 0330   13    PATH ESTABLISHED...                      *
* IF STATE = PENDING/SUSPEND:    TRACKS OUT OF SYNC =   49812      *
*                                TRACKS ON VOLUME   =   50085      *
*                               PERCENT OF COPY COMPLETE =   1%    *
*  SUBSYSTEM         WWNN                  LIC LEVEL               *
* -----------  ----------------           -----------             *
* PRIMARY....  5005076303FFC228           5.0.03.0097             *
* SECONDARY.1  5005076303FFC422                                    *
********************************************************************
CQUERY COMMAND COMPLETED FOR DEVICE 2D00. COMPLETION CODE: 00
```

Note that the CQUERY commands and their output are also written to SYSLOG. This may flood the SYSLOG when you issue many CQUERY commands. An alternative may be to query the Global Copy volume pairs and their status with ICKDSF-based query commands.

26.3.3 Establish FlashCopy relationships

Once the first pass is completed for Global Copy, establish the FlashCopy relationships between the B and C volumes. Example 26-11 shows three FCESTABL TSO commands to establish the FlashCopy pairs: one FlashCopy pair in the first LSS pair, and two FlashCopy pairs in the second LSS pair. Note that this example implies that there is a host connectivity to the remote storage disk subsystem, because the FlashCopy commands are directed to the source and target FlashCopy volumes via their z/OS device numbers. No inband FlashCopy TSO commands are used here.

Example 26-11 Establish FlashCopy pairs between B and C volume with TSO

```
//* ---------------------------- TSO ----------------------------- ***
//* FLASHCOPY B -> C START CHANGE RECORDING NOCOPY ETC. THROUGH    ***
//*                  MODE(ASYNC)                                   ***
//* ---------------------------------------------------------------- ***
//* SOURCE AND TARGET REQUIRED / ONLINTGT(YES) - JUST IN CASE      ***
//* ---------------------------------------------------------------- ***
//FCESTBL EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

   FCQUERY   DEVN (X'3C00')
   FCESTABL  SDEVN(X'3C00')  TDEVN(X'3E00') +
             MODE (ASYNC)    ONLINTGT(YES)
   FCQUERY   DEVN (X'3C00')

   FCQUERY   DEVN (X'3D00')
   FCESTABL  SDEVN(X'3D00')  TDEVN(X'3F00')   +
```


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```
            MODE (ASYNC)    ONLINTGT(YES)
   FCQUERY   DEVN (X'3D00')

   FCQUERY   DEVN (X'3D01')
   FCESTABL  SDEVN(X'3D01')  TDEVN(X'3F01')   +
             MODE (ASYNC)    ONLINTGT(YES)
   FCQUERY   DEVN (X'3D01')
```

Note the ONLINTGT parameter. Although we used here YES to make sure that the FlashCopy command successfully completes, independent of whether the target volume is online or offline, we still recommend to use the default of NO. This ensures that the FlashCopy command is only successful when the target volume is offline.

You may query the FlashCopy status of the source volumes before and after the FlashCopy establish command, to verify that a FlashCopy relationship is successfully established. See Example 26-12.

Example 26-12 FlashCopy status before and after FCESTABL

```
FCQUERY   DEVN (X'3C00')
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
3C00 3C00  0C  00 2107 000000073081      0  50099  N  S  N  N 00000000
FCQUERY COMMAND COMPLETED FOR DEVICE 3C00. COMPLETION CODE: 00
READY
   FCESTABL  SDEVN(X'3C00')  TDEVN(X'3E00')        MODE (ASYNC)    ONLINTGT(YES)
FCESTABL COMMAND COMPLETED FOR DEVICE 3C00. COMPLETION CODE: 00
READY
   FCQUERY   DEVN (X'3C00')
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
3C00 3C00  0C  00 2107 000000073081      1  50099  N  S  N  N 00000000
FCQUERY COMMAND COMPLETED FOR DEVICE 3C00. COMPLETION CODE: 00
```

This concludes the setup for Global Copy and FlashCopy. Global Copy replicates the data from the local to the remote volumes.

26.3.4 Define Global Mirror session

Example 26-13 shows the TSO command RSESSION with the ACTION parameter with the value DEFINE. This defines a Global Mirror session that involves the selected LSSs at the local site. You define the same session number to all LSSs that potentially contribute to the Global Mirror session.

Example 26-13 Define Global Mirror session to all involved LSS

```
//* ---------------------------- TSO ------------ CREATE (4) ----- ***
//* DEFINE GM SESSION NUMBER X'01' TO LSS X'0C' AND LSS X'0D'      ***
//* ------------------------------------------------------------- ***
//DEFSESS EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RSESSION   SNBR(01) VOLSER(XX2C00)          +
             ACTION(DEFINE)                   +
             LSSTYPE(CKD) LSSNBR(0C)          +
             ESSSERIAL(27131)                 +
             MSSERIAL (27131)
```


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```
  RSESSION   SNBR(01) VOLSER(XX2D00)          +
             ACTION(DEFINE)                  +
             LSSTYPE(CKD) LSSNBR(0D)         +
             ESSSERIAL(27131)                +
             MSSERIAL (27131)
```

Note that the VOLSER parameter is used to point to the LSSs that hold the Global Copy primary volumes that will be part of this Global Mirror configuration. These volumes have to be online to the system on which this job executes. This asks for a kind of utility volume within each LSS. The ACTION(DEFINE) command parameter only defines, for each LSS, a session number, which in our example is 01. It does not affect Global Copy, which is replicating the writes I/O data from the local site to the remote site.

26.3.5 Populate the session with Global Copy primary volumes

Once the session is defined to the primary LSSs, we add Global Copy primary volumes to the session. Example 26-14 shows the RVOLUME TSO command used to do this.

Example 26-14 Populate Global Mirror session with Global Copy primary volumes

```
//* --------------------------- TSO ------------ CREATE (5) ----- ***
//* POPULATE SESSION X'01' WITH PRIMARY VOLUMES                    ***
//*                                                                ***
//*          VOLUME LIST CONTAINS CCA NUMBERS                      ***
//* ---------------------------------------------------------------- ***
//JOIN    EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RVOLUME    SNBR(01) VOLSER(XX2C00)          +
             ACTION   (JOIN)                  +
             LSSTYPE  (CKD) LSSNBR(0C)        +
             ESSSERIAL(27131)                 +
             VOLLIST  (00)

  RVOLUME    SNBR(01) VOLSER(XX2D00)          +
             ACTION   (JOIN)                  +
             LSSTYPE  (CKD) LSSNBR(0D)        +
             ESSSERIAL(27131)                 +
             VOLRANGE (00:01)
/*
```

Again we need an online volume to aim into the desired LSS. The first RVOLUME command adds a volume from LSS 0C into session 01. Here we use the VOLLIST parameter that contains the channel connection address (CCA) of the Global Copy primary volume.

The second RVOLUME command adds two volumes from LSS 0D into session 01. Here, we use the VOLRANGE parameter, which contains a range of CCAs of Global Copy primary volumes. VOLRANGE reads here as CCAs from 00 to 01, which is just two volumes in this case.

Note that the Consistency Group formation has still not started. The only activity that is going on is the Global Copy replication of data between the primary and secondary volumes.

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26.3.6 Start Global Mirror session

The last step is to start the Global Mirror session. This will start forming Consistency Groups at the remote site. Also with this command, you are appointing the Master LSS.

Example 26-15 shows the TSO command RSESSION, but this time with the ACTION(START) parameter option. As this parameter option implies, the microcode now starts to create Consistency Groups at the secondary storage disk subsystem. Again, an online volume in VOLSER is required on the system where this job executes.

With the START option you can also provide the session with tuning values other than the default values. Here we decided to continuously create Consistency Groups. The maximum drain time window is set to 10 minutes. The maximum application impact time is set to 5 milliseconds, at the beginning of the process of forming a new Consistency Group.

Example 26-15 Start Global Mirror session

```
//* ---------------------------- TSO ------------ CREATE (6) ----- ***
//* START    SESSION X'01' THROUGH LSS X'0C'                       ***
//*                                                                ***
//*          THEN LSS X'0C' BECOMES THE MASTER LSS (DS)            ***
//*          NOTE: LSS SYNTAX IS WITHOUT X AND QUOTES ...          ***
//*                                                                ***
//*          CGINTERVAL - BUILD CG WITHOUT A BREAK                 ***
//*          CGDRAIN    - ALLOW 10 MINUTES FOR DRAINING THE STUFF  ***
//*          COORDINTERVAL - ALLOW 5 MS MAX FOR COORDINATION       ***
//* ------------------------------------------------------------- ***
//START   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RSESSION   SNBR(01)      VOLSER(XX2C00)    +
             ACTION       (START)            +
             LSSTYPE      (CKD) LSSNBR(0C)   +
             ESSSERIAL    (27131)            +
             MSSERIAL     (27131)            +
             CGINTERVAL   (00)               +
             CGDRAIN      (600)              +
             COORDINTERVAL(05)
/*
```

This last step concludes the step-by-step procedure, using TSO commands, for the setup of a Global Mirror environment with three Global Copy primary volumes spread over two LSSs.

26.4 Primary site failure and recovery management with TSO

This example goes through the required steps to recover from a primary site failure using TSO commands. This example starts from the configuration that was set up in 26.3, “Set up the Global Mirror environment using TSO” on page 345. The very same volumes and LSSs are used in all corresponding TSO command examples. Figure 26-2 on page 353 shows the configuration during normal operations.

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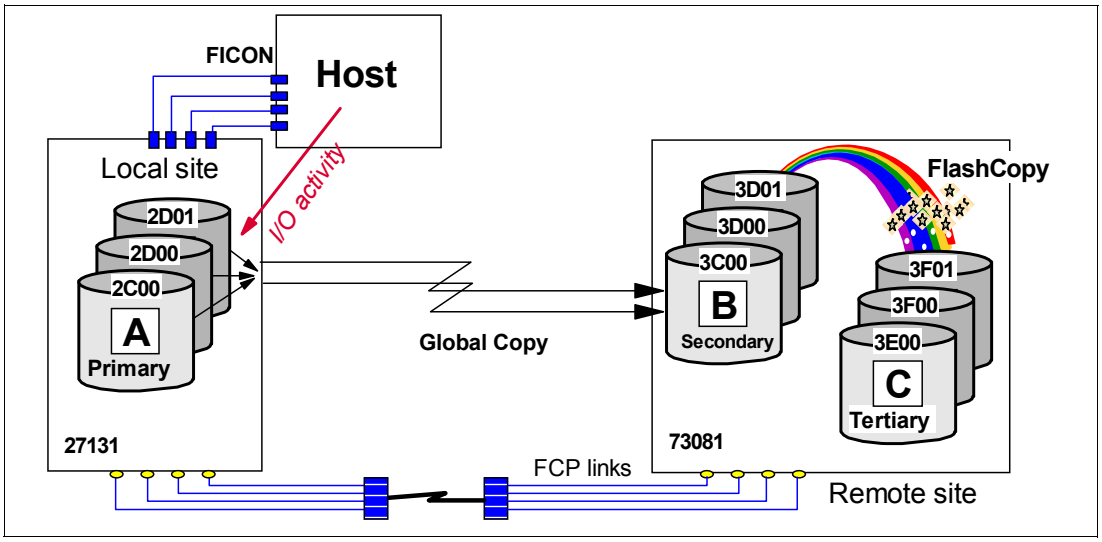

Figure 26-2 Global Mirror configuration before unplanned primary failure

The production applications write to three primary volumes that are part of a Global Mirror session.

26.4.1 Primary site failure

We simulate a primary site failure that may not be fatal to the storage disk subsystem.

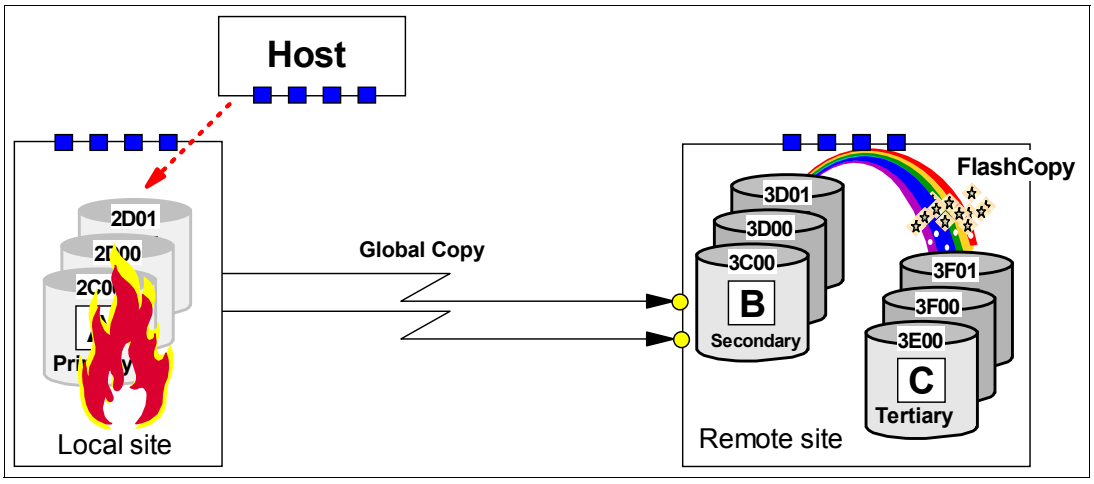

Figure 26-3 Unplanned primary site failure

In our testing environment, we simulated a primary site failure with a CGROUP FREEZE command to both primary LSSs. See Figure 26-3 and Example 26-16 on page 354.

A more strict primary volume failure may be simulated through a V OFFLINE,FORCE to the Global Copy primary volumes. This will also fail the application I/Os to the volumes. If you use this testing procedure, do not forget to reply to the corresponding WTOR for each V OFFLINE,FORCE.

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Example 26-16 Simulate primary site failure through CGROUP FREEZE

```
//* ---------------------------- TSO ------------ FAILO  (2) ----- ***
//* SIMULATE PRIMARY FAILURE WITH CGROUP FREEZE/RUN                 ***
//* HARDER PRIMARY FAILURE THROUGH VARY OFFLINE,FORCE               ***
//* ------------------------------------------------------------- ***
//FREEZE  EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CGROUP    DEVN (X'2C00')                    +
           PRIM (X'2C00' 27131 X'0C')        +
           SEC  (X'3C00' 73081 X'0C')        +
           FREEZE

 CGROUP    DEVN (X'2D00')                    +
           PRIM (X'2D00' 27131 X'0D')        +
           SEC  (X'3D00' 73081 X'0D')        +
           FREEZE

//* ------------------------------------------------------------- ***
//RUN     EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CGROUP    DEVN (X'2C00')                    +
           PRIM (X'2C00' 27131 X'0C')        +
           SEC  (X'3C00' 73081 X'0C')        +
           RUN

 CGROUP    DEVN (X'2D00')                    +
           PRIM (X'2D00' 27131 X'0D')        +
           SEC  (X'3D00' 73081 X'0D')        +
           RUN
```

CGROUP FREEZE immediately removes the paths between the primary and secondary LSSs. An immediate CGROUP RUN command would end a potential extended long busy (ELB) timer. Note that ELB is not possible and not useful for Global Copy.

26.4.2 Stop a Global Mirror session

When the local storage disk subsystem is still operational, you may explicitly stop the Global Mirror session; see Example 26-17.

Example 26-17 Stop Global Mirror session when local site is still accessible

```
//* ----------------- TSO ------------------------------------- ***
//* Terminate GM session number X'01'                           ***
//* ------------------------------------------------------------- ***
//TERM    EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RSESSION   SNBR(01) VOLSER(XX2C00)       +
             ACTION(STOP)                  +
             LSSTYPE(CKD) LSSNBR(0C)       +
             ESSSERIAL(27131)              +
```


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```
            MSSERIAL (27131)
```

Note: Address all Global Mirror session commands to the Master LSS. This is the LSS that was used when the Global Mirror START command was given

26.4.3 Failover from B to A volumes

Once the primary volumes fail and the application I/O stops at the primary site, the status of the secondary volumes (B) is changed from *secondary pending* to *primary suspended*. This is done with the ACTION(FAILOVER) on the secondary volumes; see Example 26-18.

Example 26-18 Failover from B volume to A volume

```
//* ---------------------------- TSO --------- FAILOVER (3) ------ ***
//* ESTABLISH Global Copy PAIR(S) FAILOVER B -> A                  ***
//*                                                                ***
//*   NOTE: ACTION IS NOT VALID WITH MODE(COPY)                    ***
//* ---------------------------------------------------------------- ***
//EPAIRFO EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'3C00')                    +
           PRIM (X'3C00' 73081 X'00' X'0C')  +
           SEC  (X'2C00' 27131 X'00' X'0C')  +
           ACTION(FAILOVER)                  +
           ONLINSEC(NO)  MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)                CASCADE(NO)

 CESTPAIR  DEVN (X'3D00')                    +
           PRIM (X'3D00' 73081 X'00' X'0D')  +
           SEC  (X'2D00' 27131 X'00' X'0D')  +
           ACTION(FAILOVER)                  +
           ONLINSEC(NO)  MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)                CASCADE(NO)
 CESTPAIR  DEVN (X'3D01')                    +
           PRIM (X'3D00' 73081 X'01' X'0D')  +
           SEC  (X'2D00' 27131 X'01' X'0D')  +
           ACTION(FAILOVER)                  +
           ONLINSEC(NO)  MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)                CASCADE(NO)
```

The FAILOVER parameter value does not need to communicate to the primary volumes. This parameter just changes the status of the secondary volumes to primary suspended. This includes the creation of a change recording bit map for the B volumes, which allows the re-synchronization at a later time when returning to the local site.

26.4.4 Check Global Mirror FlashCopy status between B and C volumes

At this stage you have to verify the FlashCopy status of each FlashCopy pair. For a detailed discussion on this verification activity, refer to 23.7.4, “Check for valid Consistency Group state” on page 285. In our test scenario all FlashCopy pairs were in good state, with the same FlashCopy sequence number, and all FlashCopy pairs were in non-revertible state, so no further corrective action had to be taken.

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26.4.5 Create a data consistent set of B volumes

The next step is to create a set of consistent volumes. This requires a specific FlashCopy operation, which is *fast reverse restore*, FRR; see Figure 26-4.

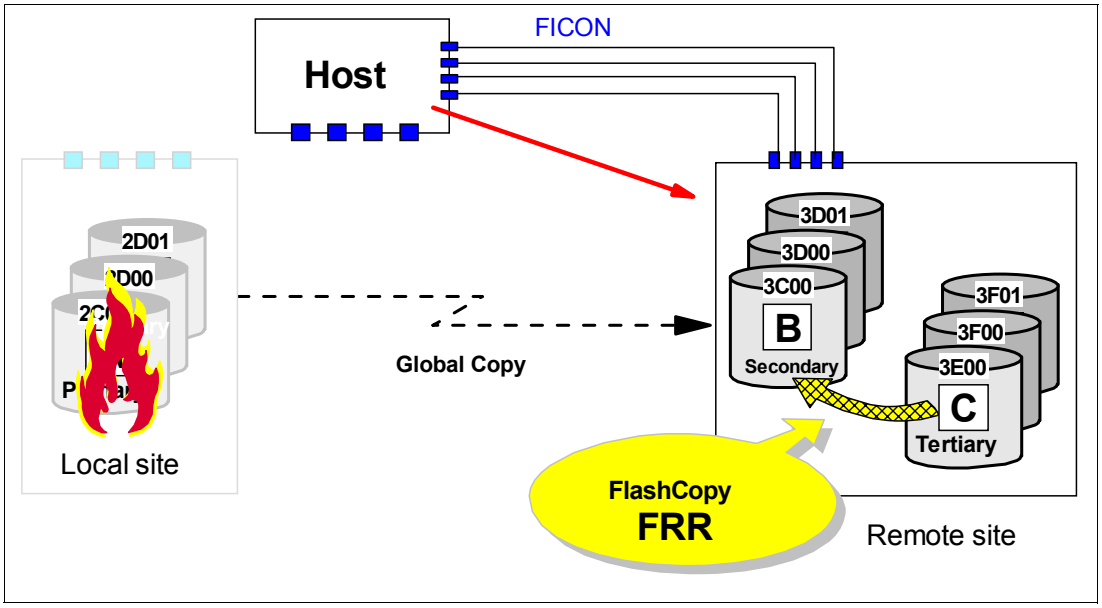

Figure 26-4 Establish FlashCopy from last consistent C to B

This FlashCopy command uses the C volume as the source volume and the B volume as the target volume.

Example 26-19 shows the ACTION(FRR) command parameter. In the example we use source and target z/OS device numbers, which implies that there is host connectivity to the secondary storage disk subsystem.

Example 26-19 Create a set of consistent B volumes

```
//* ------------------------------------------------------------- ***
//FCFRR   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 FCESTABL  SDEVN(X'3E00')  TDEVN(X'3C00') ACTION(FRR)
 FCESTABL  SDEVN(X'3F00')  TDEVN(X'3D00') ACTION(FRR)
 FCESTABL  SDEVN(X'3F01')  TDEVN(X'3D01') ACTION(FRR)
```

The FCESTABL command with the ACTION(FRR) parameter value does a background copy operation that copies only the changed tracks from the C to the B volumes, those which changed since the last Consistency Group formation. Once the background copy completes, the FlashCopy relationship between the C and B volumes is withdrawn and ends. After that, the C volumes are not usable and only the B volumes are now a set of data consistent volumes.

26.4.6 Optionally create a data consistent set of D volumes

Optionally, you can create a second copy of valid data by doing a copy of the B volumes on a set of D volumes. Example 26-20 on page 357 shows how to do this.

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Example 26-20 Create optional second copy of data consistent D volumes

```
//* ---------------------------- TSO ------------ CREATE (5) ----- ***
//* FLASHCOPY B -> D TO CREATE COPY TO WORK (TEST) WITH            ***
//* ------------------------------------------------------------- ***
//FCESTBL EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

   FCESTABL  SDEVN(X'3C00')  TDEVN(X'3E02')
   FCQUERY   DEVN (X'3C00')

   FCESTABL  SDEVN(X'3D00')  TDEVN(X'3F02')
   FCQUERY   DEVN (X'3D00')

   FCESTABL  SDEVN(X'3D01')  TDEVN(X'3F03')
   FCQUERY   DEVN (X'3D01')
```

26.4.7 Create a data consistent set of C volumes

We recommend to create a second set of consistent data on the C volumes after you have created the B volumes as described in 26.4.5, “Create a data consistent set of B volumes” on page 356.

Example 26-21 Setup Global Mirror FlashCopy between B and C volumes again

```
//* ---------------------------- TSO ---------------------------- ***
//* FLASHCOPY B -> C START CHANGE RECORDING NOCOPY ETC. THROUGH    ***
//*                 MODE(ASYNC) OPTION (GET READY FOR GM)          ***
//* ------------------------------------------------------------- ***
//FCESTBL EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 FCESTABL  SDEVN(X'3C00') TDEVN(X'3E00')  MODE(ASYNC)
 FCQUERY   DEVN (X'3C00')

 FCESTABL  SDEVN(X'3D00') TDEVN(X'3F00')  MODE(ASYNC)
 FCQUERY   DEVN (X'3D00')

 FCESTABL  SDEVN(X'3D01') TDEVN(X'3F01')  MODE(ASYNC)
 FCQUERY   DEVN (X'3D01')
```

Example 26-21 does a reestablish of the previous Global Mirror FlashCopy relationship between the B and C volumes. This prepares the configuration for returning to the local site and resuming Global Mirror as it used to be. At the same time, it also provides another copy of data consistent volumes on the C volumes. Upon this the B volumes and the C volumes are identical.

If you have to restart again because a previous restart to the B volumes was faulty, or the restart was not set up correctly, you may flash again from C to B to recreate a data consistent set of volumes on the B volumes.

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26.4.8 Prepare to return to the local site

At some time you will plan to return to the local site. The intention here is to apply the changes from the B volumes to the A volumes before resuming operations at the local site. Before you can apply these changes from the B to the A volumes, you have to establish paths from B to A.

26.4.9 Replicate the changes from B to A

With the Global Copy paths between B and A defined, you may still be running the application at the remote site, so updates keep arriving to the B volumes. Using the ACTION(FAILBACK) parameter, we apply the changes from the B volumes to the A volumes; see Figure 26-5.

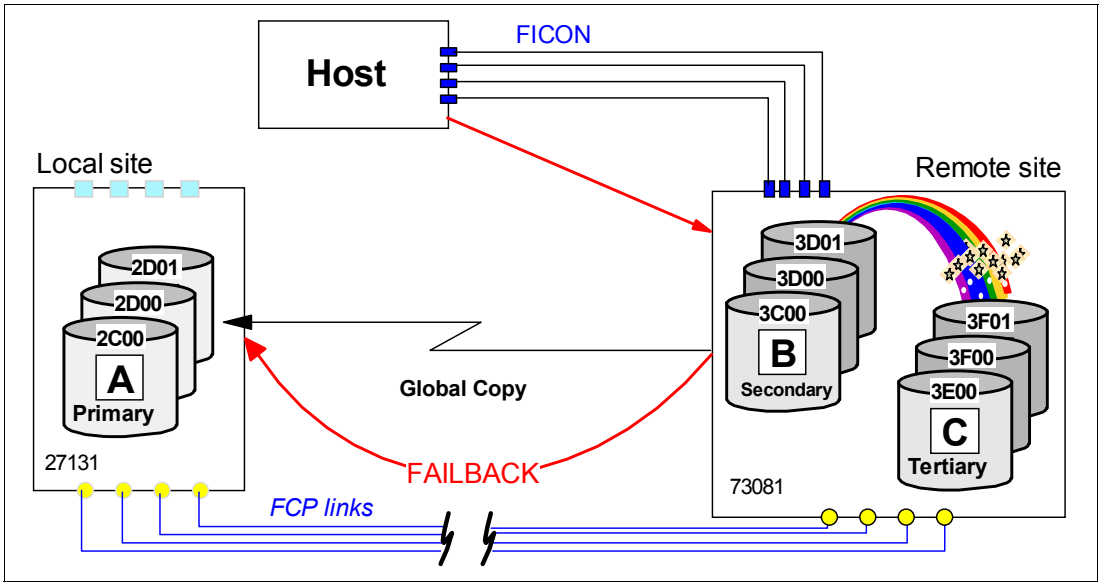

Figure 26-5 Failback operation from B to A to prepare return to the local site

Example 26-22 illustrates how the failback is done using TSO commands. The failback operation addresses the B volumes at the secondary site.

Example 26-22 Failback operation from B to A to prepare return to the local site

```
//* ---------------------------- TSO ----------------------------- ***
//* ESTABLISH Global Copy  PAIR(S) FAILBACK B -> A  ONCE A IS BACK ***
//* ------------------------------------------------------------- ***
//EPAIRFB EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'3C00')                    +
           PRIM (X'3C00' 73081 X'00' X'0C')  +
           SEC  (X'2C00' 27131 X'00' X'0C')  +
           ACTION(FAILBACK)                  +
                        MSGREQ(NO)  CRIT(NO) +
           OPTION(XD)               CASCADE(NO)

 CESTPAIR  DEVN (X'3D00')                    +
           PRIM (X'3D00' 73081 X'00' X'0D')  +
           SEC  (X'2D00' 27131 X'00' X'0D')  +
           ACTION(FAILBACK)                  +
```


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```
                    MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                CASCADE(NO)
 CESTPAIR  DEVN (X'3D01')                    +
          PRIM (X'3D00' 73081 X'01' X'0D')   +
          SEC  (X'2D00' 27131 X'01' X'0D')   +
          ACTION(FAILBACK)                   +
                    MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                CASCADE(NO)
```

26.4.10 Return to the local site and resume Global Mirror

At some time you will plan to return the application to the local site. This requires first that you quiesce the application at the remote site. Then, you execute an ACTION(FAILOVER)/ ACTION(FAILBACK) command sequence to the A volumes. This changes the Global Copy direction, and leaves the A and B volumes in the same state as they originally were, before the outage occurred. These commands are very quick because there is no data to replicate.

Example 26-23 shows the failover/failback sequence that is performed on the A volumes.

Example 26-23 Failover and Failback operations to the A volumes

```
//* ---------------------------- TSO --------- FAILOVER ---------- ***
//* ESTABLISH Global Copy PAIR(S) FAILOVER A -> B                  ***
//* ---------------------------------------------------------------- ***
//EPAIRFO EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'2C00')                    +
          PRIM (X'2C00' 27131 X'00' X'0C')   +
          SEC  (X'3C00' 73081 X'00' X'0C')   +
          ACTION(FAILOVER)                   +
                    MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                CASCADE(NO)

 CESTPAIR  DEVN (X'2D00')                    +
          PRIM (X'2D00' 27131 X'00' X'0D')   +
          SEC  (X'3D00' 73081 X'00' X'0D')   +
          ACTION(FAILOVER)                   +
                    MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                CASCADE(NO)
 CESTPAIR  DEVN (X'2D01')                    +
          PRIM (X'2D00' 27131 X'01' X'0D')   +
          SEC  (X'3D00' 73081 X'01' X'0D')   +
          ACTION(FAILOVER)                   +
                    MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                CASCADE(NO)


//* ---------------------------- TSO ---------------------------- ***
//* ESTABLISH Global Copy PAIR(S) FAILBACK A -> B                  ***
//* ---------------------------------------------------------------- ***
//EPAIRFB EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

 CESTPAIR  DEVN (X'2C00')                    +
```


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```
          PRIM (X'2C00' 27131 X'00' X'0C')   +
          SEC  (X'3C00' 73081 X'00' X'0C')   +
          ACTION(FAILBACK)                   +
                       MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                 CASCADE(NO)

CESTPAIR  DEVN (X'2D00')                     +
          SEC  (X'3D00' 73081 X'00' X'0D')   +
          PRIM (X'2D00' 27131 X'00' X'0D')   +
          ACTION(FAILBACK)                   +
                       MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                 CASCADE(NO)
CESTPAIR  DEVN (X'2D01')                     +
          SEC  (X'3D00' 73081 X'01' X'0D')   +
          PRIM (X'2D00' 27131 X'01' X'0D')   +
          ACTION(FAILBACK)                   +
                       MSGREQ(NO)  CRIT(NO) +
          OPTION(XD)                 CASCADE(NO)
```

From now on the normal operation is restored, and as the production applications resume the I/O at the local site, Global Copy will be replicating the data to the remote site, as before the site failure occurred.

Restart Global Mirror session

Finally, to restore everything as it was, you need to restart Global Mirror to resume the Consistency Group formation process.

26.5 Remove Global Mirror environment using TSO

To remove a Global Mirror environment, follow these steps in the following order:

1. Stop the session.
2. Remove volumes from the session.
3. Delete the session.
4. Withdraw the FlashCopy relationships.
5. Delete the Global Copy pairs.
6. Remove the paths.

The following sections go step-by-step through this procedure, and show how to execute each of the steps using TSO commands.

26.5.1 Stop Global Mirror session

The first thing to do is to stop the Global Mirror session. Example 26-24 shows the TSO command used to stop the session.

Example 26-24 Stop Global Mirror session

```
//* ------------------ TSO -------------------- CLEANUP (1) ------ ***
//* Terminate GM session number X'01'           first thing to do  ***
//* ------------------------------------------------------------- ***
//TERM    EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RSESSION   SNBR(01) VOLSER(XX2C00)          +
```


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```
            ACTION(STOP)                    +
            LSSTYPE(CKD) LSSNBR(0C)         +
            ESSSERIAL(27131)                +
            MSSERIAL (27131)

  RQUERY    SNBR(01) VOLSER(XX2C00) ACTION(DVCSTAT)
  RQUERY    SNBR(01) VOLSER(XX2C00) ACTION(GMLSTAT)
  RQUERY    SNBR(01) VOLSER(XX2C00) ACTION(GMPSTAT)
```

The GMPSTAT query shown in Example 26-25 informs that session 01 is not active any longer. Numbers are reset to zeros.

Example 26-25 Session query after session stop

```
RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(GMPSTAT)

RQUERY Output Volser(XX2C00) Action(GMPSTAT) Version(001)
SNbr LSS GMPStatus  TotVol OOSVol OOSTrks
--   --  ---------- ------ ------ --------
01   0C  NotStarted 1      0      00000000
```

26.5.2 Remove volumes from the session

After the session has been stopped, remove the Global Mirror primary volumes from the session. Example 26-26 shows how to do this. The RQUERY commands are used to verify the status of the devices after their removal from the session.

Example 26-26 Remove volumes from the session

```
//* ------------------ TSO ----------------- CLEANUP (2) --------- ***
//* REMOVE VOLUMES FROM SESSION NUMBER 01  AFTER SESSION STOPPED   ***
//*                                                                ***
//*          VOLUME LIST CONTAINS CCA NUMBERS                      ***
//* -------------------------------------------------------------- ***
//REMOVE  EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RVOLUME   SNBR(01) VOLSER(XX2C00)         +
            ACTION(REMOVE)                  +
            LSSTYPE(CKD) LSSNBR(0C)         +
            ESSSERIAL(27131)                +
            VOLLIST  (00)

  RVOLUME   SNBR(01) VOLSER(XX2D00)         +
            ACTION(REMOVE)                  +
            LSSTYPE(CKD) LSSNBR(0D)         +
            ESSSERIAL(27131)                +
            VOLLIST  (00,01)

  RQUERY    SNBR(01) VOLSER(XX2C00) ACTION(DVCSTAT)
  RQUERY    SNBR(01) VOLSER(XX2D00) ACTION(DVCSTAT)
```

The RQUERY commands, after the Global Copy primary volumes have been removed, still display the session number 01, but no longer any volumes. This is shown in Example 26-27 on page 362.

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Example 26-27 Query Global Mirror volumes after removal

```
RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(DVCSTAT)

RQUERY Output Volser(XX2C00) Action(DVCSTAT) Version(001)
SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
--   --  --  -------------------- ----------  ----------
01           NoVolumes
READY

RQUERY     SNBR(01) VOLSER(XX2D00) ACTION(DVCSTAT)

RQUERY Output Volser(XX2D00) Action(DVCSTAT) Version(001)
SNbr LSS Dvc VolStat              PriPPRCStat SecCascStat
--   --  --  -------------------- ----------  ----------
01           NoVolumes
```

26.5.3 Delete the Global Mirror session

The next step is to delete the Global Mirror session from all the involved LSSs. Example 26-28 shows how to do this.

Example 26-28 Delete the Global Mirror session from all involved LSSs

```
//* ------------------ TSO ----------------- CLEANUP (3) --------- ***
//* UNdefine GM session number X'01' through both involved LSS #s  ***
//* ==                                                             ***
//* ------------------------------------------------------------- ***
//UNDEFINE EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

  RSESSION   SNBR(01) VOLSER(XX2C00)           +
             ACTION(UNDEFINE)                  +
             LSSTYPE(CKD) LSSNBR(0C)           +
             ESSSERIAL(27131)                  +
             MSSERIAL (27131)

  RSESSION   SNBR(01) VOLSER(XX2D00)           +
             ACTION(UNDEFINE)                  +
             LSSTYPE(CKD) LSSNBR(0D)           +
             ESSSERIAL(27131)                  +
             MSSERIAL (27131)

  RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(DVCSTAT)
  RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(GMLSTAT)
  RQUERY     SNBR(01) VOLSER(XX2C00) ACTION(GMPSTAT)
```

26.5.4 Remove FlashCopy relationships

After the Global Mirror session is removed and deleted, you may remove the FlashCopy relationships between the B and C volumes. Example 26-29 on page 363 shows how to do this.

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Example 26-29 Remove FlashCopy relationships

```
//* ------------------ TSO ----------------- CLEANUP (4) --------- ***
//* Remove FlashCopy relationship from B -> C                      ***
//* ------------------------------------------------------------- ***
//FCWDRW  EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

   FCQUERY   DEVN (X'3C00')
   FCWITHDR  SDEVN(X'3C00')  TDEVN(X'3E00')
   FCQUERY   DEVN (X'3C00')

   FCQUERY   DEVN (X'3D00')
   FCWITHDR  SDEVN(X'3D00')  TDEVN(X'3F00')
   FCQUERY   DEVN (X'3D00')

   FCQUERY   DEVN (X'3D01')
   FCWITHDR  SDEVN(X'3D01')  TDEVN(X'3F01')
   FCQUERY   DEVN (X'3D01')
```

You may verify, with a last FlashCopy query, that the FlashCopy relationships are removed. Example 26-30 illustrates this.

Example 26-30 FCQUERY commands and their output

```
READY
   FCQUERY   DEVN (X'3C00')
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
3C00 3C00  0C  00 2107 000000073081      1  50099  N  S  N  N 429334DE
FCQUERY COMMAND COMPLETED FOR DEVICE 3C00. COMPLETION CODE: 00
READY
   FCWITHDR  SDEVN(X'3C00')  TDEVN(X'3E00')
FCWITHDR COMMAND COMPLETED FOR DEVICE 3C00. COMPLETION CODE: 00
READY
   FCQUERY   DEVN (X'3C00')
FCQUERY Formatted -2
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX XC PC CC RV  SEQNUM
3C00 3C00  0C  00 2107 000000073081      0  50099  N  S  N  N 00000000
FCQUERY COMMAND COMPLETED FOR DEVICE 3C00. COMPLETION CODE: 00
READY
```

The `ACT` column with the number `1` indicates an active FlashCopy relationship. The `0` (zero) in the FlashCopy query, after the FlashCopy withdraw command, indicates that the FlashCopy relationship is removed.

26.5.5 Delete Global Copy volume pairs

Remove all Global Copy volume pair relationships. Example 26-31 on page 364 shows the TSO commands that are used for this.

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Example 26-31 Delete Global Copy volume pairs

```
//* ----------------- TSO ---------------- CLEANUP (5) ---------- ***
//* Delete Global Copy volumes pairs                               ***
//*                                                                ***
//*          DELETE PRIMARY X'2C00'                                ***
//*                         X'2D00'                                ***
//*                         X'2D01'                                ***
//*                                                                ***
//*        PRIM(X'2C00' 27131 X'00' X'0C')                         ***
//*              SSID  #####  CCA   LSS                            ***
//* -------------------------------------------------------------- ***
//DPAIR   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN
//SYSTSIN   DD DDNAME=SYSIN

 CQUERY    DEVN(X'2C00')
 CQUERY    DEVN(X'2D00')
 CQUERY    DEVN(X'2D01')

 CDELPAIR  DEVN(X'2C00')                              +
           PRIM(X'2C00' 27131 X'00' X'0C')            +
           SEC (X'3C00' 73081 X'00' X'0C')
 CDELPAIR  DEVN(X'2D00')                              +
           PRIM(X'2D00' 27131 X'00' X'0D')            +
           SEC (X'3D00' 73081 X'00' X'0D')
 CDELPAIR  DEVN(X'2D01')                              +
           PRIM(X'2D00' 27131 X'01' X'0D')            +
           SEC (X'3D00' 73081 X'01' X'0D')

 CQUERY    DEVN(X'2C00')
 CQUERY    DEVN(X'2D00')
 CQUERY    DEVN(X'2D01')
```

You may check the status of the Global Copy primary volumes before and after the CDELPAIR command sequence. Example 26-32 and Example 26-33 show the CQUERY commands and their formatted output.

Example 26-32 CQUERY before deleting the Global Copy pair

```
READY
 CQUERY    DEVN(X'2C00')
CQUERY FORMATTED LVL 3
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 2C00  PRIMARY..  PENDING.XD   ACTIVE..   2C00 00 0C   3C00 00 0C *
*       CRIT(NO).......       CGRPLB(NO). 000000027131 000000073081*
* PATHS PFCA SFCA STATUS: DESCRIPTION                              *
* ----- --------- ------  -------------------                      *
*   4   0030 0030   13    PATH ESTABLISHED...                      *
*       0130 0130   13    PATH ESTABLISHED...                      *
*       0230 0230   13    PATH ESTABLISHED...                      *
*       0331 0330   14    (UNDETERMINED).....                      *
*  SUBSYSTEM         WWNN                  LIC LEVEL              *
* -----------  ----------------           -----------            *
```


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```
* PRIMARY....  5005076303FFC228            5.0.03.0097             *
* SECONDARY.1  5005076303FFC422                                    *
********************************************************************
```

Example 26-33 CQUERY after deleting the Global Copy pair

```
READY
 CQUERY    DEVN(X'2C00')
CQUERY FORMATTED LVL 3
VOLUME REPORT
************** PPRC REMOTE COPY CQUERY - VOLUME ********************
*                                        (PRIMARY)   (SECONDARY) *
*                                       SSID CCA LSS SSID CCA LSS*
*DEVICE   LEVEL      STATE     PATH STATUS  SERIAL#     SERIAL#    *
*------ ---------  ----------  ----------- ---------    ---------  *
* 2C00  .........  SIMPLEX...   INACTIVE   2C00 00 0C   .......... *
*       ...............       ..... 000000027131 .....           *
* PATHS SAID DEST STATUS: DESCRIPTION                              *
* ----- --------- ------  -------------------                      *
*   0   ---- ----   00    NO PATH.....                             *
*       ---- ----   00    NO PATH.....                             *
*       ---- ----   00    NO PATH.....                             *
*       ---- ----   00    NO PATH.....                             *
*  SUBSYSTEM         WWNN                 LIC LEVEL               *
* -----------  ----------------           -----------             *
* PRIMARY....  5005076303FFC228            5.0.03.0097             *
* SECONDARY.1  5005076303FFC422                                    *
********************************************************************
CQUERY COMMAND COMPLETED FOR DEVICE 2C00. COMPLETION CODE: 00
```

Note that this bulky formatted output is also written to SYSLOG. When you issue many CQUERY commands at once, it is going to flood your SYSLOG. And this is going to quickly exhaust the WTO buffers, which will lead to the corresponding buffer shortage messages. There is also an unformatted output of the CQUERY command that provides the same information as the formatted output, but in fewer output lines; see Example 26-34.

Example 26-34 CQUERY unformatted output

```
READY
   CQUERY    DEVN (X'2C00')       UNFORMAT
CQUERY UNFORMATTED LVL 3
VOLUME REPORT
2C00,,SIMPLEX,INACTIVE,
2C00OC,00,000000027131,,,,,
,,,,,,,,,
,,,
5005076303FFC228,5005076303FFC422,
,,
CQUERY COMMAND COMPLETED FOR DEVICE 2C00. COMPLETION CODE: 00
```

This format is more difficult to read and requires knowledge about the positional output information. Refer to *z/OS DFSMS Advanced Copy Services*, SC35-0428 for details.

26.5.6 Remove the paths

Last but not least, remove the Global Copy paths between the local and remote LSSs. Example 26-35 on page 366 illustrates how to do this.

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Example 26-35 Remove the paths

```
//* ----------------- TSO ----------------- CLEANUP (6) --------- ***
//* Delete path(s)              this completes the GM cleanup     ***
//* ------------------------------------------------------------- ***
//DPATH   EXEC PGM=IKJEFT01
//SYSPRINT  DD SYSOUT=*
//SYSTSPRT  DD SYSOUT=*
//SYSTSIN   DD DDNAME=SYSIN

   CQUERY    DEVN(X'2C00') PATHS
   CDELPATH  DEVN(X'2C00')                          +
             PRIM(X'2C00'  5005076303FFC228  X'0C') +
             SEC (X'3C00'  5005076303FFC422  X'0C')
   CQUERY    DEVN(X'2C00') PATHS

   CQUERY    DEVN(X'2D00') PATHS
   CDELPATH  DEVN(X'2D00')                          +
             PRIM(X'2D00'  5005076303FFC228  X'0D') +
             SEC (X'3D00'  5005076303FFC422  X'0D')
   CQUERY    DEVN(X'2D00') PATHS
```

This concludes the example of how to remove the Global Mirror environment that was set up in 26.3, “Set up the Global Mirror environment using TSO” on page 345.

26.6 Planned outage management using ICKDSF

This section briefly presents an example of a Global Mirror planned outage that is managed using ICKDSF. The procedure presented here can be used to control a planned Global Mirror outage that is done to create a data consistent set of D volumes at the remote site.

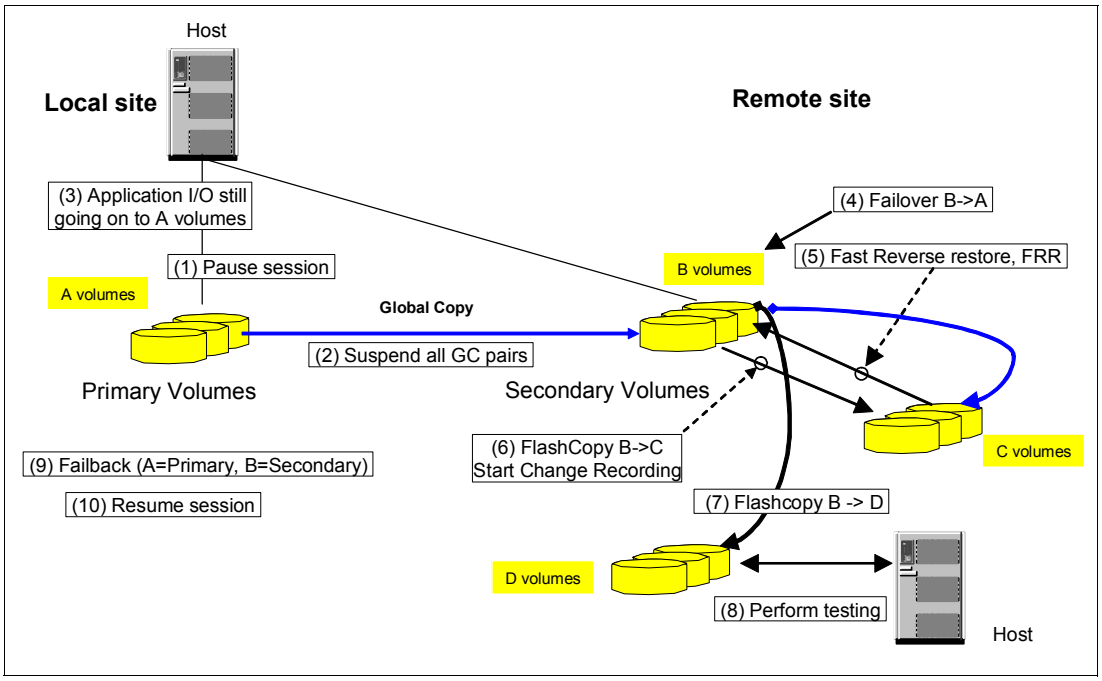

Figure 26-6 Global Mirror planned outage scenario

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Figure 26-6 summarizes the scenario. The numbers indicate the sequence of events and main considerations, and also relate to Figure 26-7 where the corresponding ICKDSF commands are shown.

The sequence of steps for a Global Mirror planned outage is as follows:

1. Pause the Global Mirror session.
2. Suspend Global Copy pairs.
3. Application I/O continues all the time.
4. Failover from B to A. This turns the B volumes into Global Copy primary suspended.
5. Create a data consistent set of B volumes. This is done with a Fast Reverse Restore (FRR) from the C to the B volumes.
6. Reestablish Global Mirror FlashCopy relationships from B to C. Both volumes are identical afterwards.
7. Optionally create a data consistent set of D volumes.
8. Use the D volumes for test or other purposes.
9. In order to prepare and continue with Global Mirror, apply the changes that were accumulated at the local site from the A volumes to the B volumes. This is done with a Failback operation with the A volumes as primary and the B volumes as secondary.
10. Resume Global Mirror.

Figure 26-7 shows the corresponding ICKDSF commands for each step of the procedure.

(1) Pause session

```
PPRCOPY DDNAME(DD01) TMASYNC -
        SESSNO(001)          -
        PAUSE                -
        MASTER
```

(2) Suspend all XD pairs

```
PPRCOPY DDNAME(DD01) SUSPEND     -
        LSS(X'05' X'00')         -
        PRI(X'E500' 27310 X'00') -
        SEC(X'7000' 22399 X'00')
```

(4) FAILOVER B->A

```
PPRCOPY UNIT (7000) ESTPAIR      -
        FAILOVER                 -
        PRI(X'7000' 22399 X'00') -
        SEC(X'E500' 27310 X'00') -
        LSS(X'00',X'05')         -
        OPTION(XD)
```

(5) Fast Reverse restore, FRR

```
FC      UNIT(7100)    ESTABLISH      /* C VOLUME                */ -
        TARGETVOL(X'00',X'00',7000)  /* B VOLUME                */ -
        FASTREVERSERESTORE           /* REVERSE DIRECTION       */ -
        MODE              (COPY)     /* START BACKGROUNDCOPY    */ -
        ONLINTGT          (YES)                                    -
        TGTOKPRIM         (YES)                                    -
        TGTCANCOMEONLINE  (NO)
```

(6) FlashCopy B->C Start Change Recording

```
FC      UNIT(7000)        ESTABLISH                                -
        TARGETVOL         (X'01',X'00',7100)                       -
        CHRCD             (YES)      /* CHANGE RECORDING      */ -
        NOTGTWR           (YES)      /* INHIBIT TARGET WRITES */ -
        MODE              (NOCOPY)   /* NO BACKGROUND COPY    */ -
        ONLINTGT          (YES)                                    -
        TGTCANCOMEONLINE  (NO)
```

(7) Flashcopy B -> D

```
FC      UNIT(7000)        ESTABLISH          /* B VOLUME     */ -
        TARGETVOL         (X'01',X'10',7110) /* D VOLUME     */ -
        ONLINTGT          (YES)                                 -
        TGTCANCOMEONLINE  (NO)
```

(9) FAILBACK (A=Primary, B=Secondary)

```
PPRCOPY DDNAME(DD01) ESTPAIR              /* A VOLUME     */ -
        FAILBACK                                            -
        PRI          (X'E500' 27310 X'00') /* A VOLUME     */ -
        SEC          (X'7000' 22399 X'00') /* B VOLUME     */ -
        LSS          (X'05',X'00')                          -
        OPTION       (XD)
```

(10) Resume session

```
PPRCOPY DDNAME(DD01) STASYNC     -
        MODIFY                   -
        SESSNO(001)              -
        CGIT(0)                  -
        MXCT(3)                  -
        MXDT(030)
```

Figure 26-7 ICKDSF command sequence for Global Mirror planned outage

Note that in most command examples ICKDSF refers to a corresponding JCL DD statement through the DDNAME parameter. This DD statement points to the LSS or volume.

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For ICKDSF command details, refer to *Device Support Facility User's Guide and Reference*, SC35-0033.

26.7 Remove a Global Mirror environment using ICKDSF

This section shows how to use ICKDSF to end and remove a Global Mirror environment that was previously established using TSO commands.

The steps of the procedure to follow are similar for any of the interfaces. In our example in this section, we use ICKDSF to accomplish the associated task for each step. These are the steps we followed to remove the Global Mirror environment:

1. Stop the session.
2. Remove volumes from the session.
3. Withdraw the FlashCopy relationships.
4. Delete the session.
5. Delete the Global Copy pairs.
6. Remove the paths.

26.7.1 Stop Global Mirror session

Example 26-36 shows the ICKDSF JCL and command lines used to stop the Global Mirror session.

Example 26-36 End Global Mirror session using ICKDSF

```
//* ------------------------------------------------------------- ***
//TERMSESS EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) TMASYNC     -
         SESSNO(001)              -
         TERMINATE                -
         MASTER
/*
```

We used a JCL DD statement to point to the Master LSS, which manages the Global Mirror session number 001. We stop the session using the TMASYNC command with the TERMINATE parameter, in the command lines for ICKDSF.

26.7.2 Remove volumes from the session

The command shown in Example 26-37 on page 369 removes four volumes from the Global Mirror session. The range of volumes to be removed is identified by the CCA range indicated in the RVOLLIST parameter. The first CCA indicates the beginning of the range, and the second CCA marks the end of the range. Do not forget to also provide the RANGE keyword.

The DDNAME parameter in the ICKDSF command line points to the JCL DD that addresses the LSS that contains the range of volumes to be removed. The JCL DD uses a utility volume for addressing purposes (VOL=SER=AA6000), which is also one of the volumes to be removed. Note that the volumes must be online.

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Example 26-37 Remove volumes from a Global Mirror session with ICKDSF

```
//* ------------------------------------------------------------- ***
//REMOVE  EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) POPSESS         -
         REMOVE                       -
         SESSNO   (001)               -
         VOLCOUNT (1)                 -
         RANGE    (YES)               -
         RVOLLIST ((X'00',X'03'))
```

26.7.3 Withdraw FlashCopy relationships

We are going to withdraw the FlashCopy relationships between the B and C volumes using ICKDSF inband commands. This means directing the FlashCopy withdraw command, and the actual I/O, to the corresponding Global Copy primary volumes.

As Example 26-38 shows, this is done with the JCL DD statements identifying the corresponding Global Copy primary volumes. The FlashCopy withdraw is actually directed to the FlashCopy source volumes, which are identified by the SRCVOL parameters. The FlashCopy target volumes are identified by the TGTVOL parameters.

Example 26-38 ICKDSF withdraw via an inband FlashCopy command

```
//* ------------------------------------------------------------- ***
//* FLASHCOPY WITHDRAW (B -> C VOLUME RELATIONSHIP)               ***
//* ------------------------------------------------------------- ***
//*   SRCVOL (X'LSS' X'CCA' X'SSID' SERIAL#)                      ***
//*   TGTVOL (X'LSS' X'CCA' DEVICE#)                              ***
//* ------------------------------------------------------------- ***
//* ------------------------------------------------------------- ***
//WITHDRW EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//DD02      DD UNIT=3390,VOL=SER=AA6001,DISP=SHR
//DD03      DD UNIT=3390,VOL=SER=AA6002,DISP=SHR
//DD04      DD UNIT=3390,VOL=SER=AA6003,DISP=SHR
//SYSIN     DD *

 FC  DDNAME(DD01)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'00',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'00',6400)        /* C VOLUME     */

 FC  DDNAME(DD02)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'01',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'01',6401)        /* C VOLUME     */

 FC  DDNAME(DD03)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'02',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'02',6402)        /* C VOLUME     */

 FC  DDNAME(DD04)   WD                        /* WITHDRAW     */ -
     SRCVOL         (X'00',X'03',0002,AAVCA)  /* B VOLUME     */ -
     TGTVOL         (X'01',X'03',6403)        /* C VOLUME     */
```


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Note the different positional parameters for SRCVOL and TGTVOL. It is possible to mix these up. First comes the LSS number and then the CCA. This is the same for both parameters. The third positional parameter for SRCVOL is the SSID, followed by the serial number of the secondary storage disk subsystem. The third parameter in TGTVOL is the actual z/OS device number of the FlashCopy target volume. Withdraw can be abbreviated as WD.

Note again that ICKDSF requires the DDNAME parameter when you refer to an online volume. Volumes AA6000 to AA6003 are in the local storage disk subsystem that is connected, over a path, to the remote disk subsystem that has the serial number AAVCA.

26.7.4 Delete the Global Mirror session

Example 26-39 shows the next step, which removes the session number 01 from the LSS that is pointed to by the DDNAME parameter.

Example 26-39 Delete or remove a session from concerned LSS

```
//* ------------------------------------------------------------- ***
//CLOSESS EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) DEFSESS     -
         SESSNO(001)              -
         CLOSE
/*
```

Again, the DDNAME parameter is required because the PPRCOPY command points to the desired LSS with an online volume. Note that, although the command is called DEFSESS (or DEFINESESSION), the session is actually removed, because of the CLOSE parameter.

26.7.5 Delete Global Copy pairs

After all traces of session number 01 are removed, the next step is to delete the Global Copy pairs. Example 26-40 shows how to do it with ICKDSF.

Example 26-40 Delete Global Copy pairs with ICKDSF

```
//* ------------------------------------------------------------- ***
//DELPAIR EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DD01      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//DD02      DD UNIT=3390,VOL=SER=AA6001,DISP=SHR
//DD03      DD UNIT=3390,VOL=SER=AA6002,DISP=SHR
//DD04      DD UNIT=3390,VOL=SER=AA6003,DISP=SHR
//SYSIN     DD *

 PPRCOPY DDNAME(DD01) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'00') -
         SEC(X'0002' AAVCA X'00')

 PPRCOPY DDNAME(DD02) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'01') -
         SEC(X'0002' AAVCA X'01')
```


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```
 PPRCOPY DDNAME(DD03) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'02') -
         SEC(X'0002' AAVCA X'02')

 PPRCOPY DDNAME(DD04) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'03') -
         SEC(X'0002' AAVCA X'03')
```

For each single Global Copy pair you must specify a corresponding PPRCOPY command. The syntax for the ICKDSF command is slightly different from the equivalent TSO command. Again, the DDNAME parameter is required because the Global Copy primary volumes are usually online with the system that issues the application I/Os. And this is the same system where the ICKDSF job is executing.

ICKDSF, in contrast to TSO commands, does not propagate all commands and their results to the z/OS SYSLOG. This can be an advantage over TSO commands. TSO commands always appear in the SYSLOG with their results, which is valuable if you want to track the TSO commands that you issued interactively in ISPF 6 or from the TSO READY state.

Example 26-41 shows a SYSLOG fragment with the output lines caused by the ICKDSF job that deletes the four Global Copy pairs. You can see in the example that when the volumes are online, ERP issues the state change message `IEA494I`.

Example 26-41 Delete Global Copy pairs with ICKDSF - SYSLOG output

```
$HASP100 WBDELPR  ON INTRDR       ICKDSF PPRC          FROM TSU01210 WB
IRR010I  USERID WB       IS ASSIGNED TO THIS JOB.
ICH70001I WB       LAST ACCESS AT 09:29:14 ON THURSDAY, JUNE 16, 2005
$HASP373 WBDELPR  STARTED - INIT 2    - CLASS B - SYS GDP5
IEF403I WBDELPR - STARTED - TIME=09.36.00
IEA494I 6000,AA6000,PPRC PAIR TERMINATED,SSID=2060,CCA=00
IEA494I 6001,AA6001,PPRC PAIR TERMINATED,SSID=2060,CCA=01
IEA494I 6002,AA6002,PPRC PAIR TERMINATED,SSID=2060,CCA=02
IEA494I 6003,AA6003,PPRC PAIR TERMINATED,SSID=2060,CCA=03
JOBNAME  PROCSTEP STEPNAME  CPU TIME      EXCPS     RC
WBDELPR  --NONE-- DELPAIR   00:00:00         49     00
IEF404I WBDELPR - ENDED - TIME=09.36.00
$HASP395 WBDELPR  ENDED
$HASP309 INIT 2    INACTIVE ******** C=SODAB
SE '09.36.00 JOB01228 $HASP165 WBDELPR  ENDED AT WSC245  MAXCC=0',LOGON,
USER=(WB)
```

Example 26-42 shows that the ICKDSF job output contains all details about each single command executed.

Example 26-42 ICKDSF output for the DELPAIR command

```
PPRCOPY DDNAME(DD01) DELPAIR     -
         LSS(X'00' X'00')         -
         PRI(X'2060' AAGXA X'00') -
         SEC(X'0002' AAVCA X'00')
ICK00700I DEVICE INFORMATION FOR 6000 IS CURRENTLY AS FOLLOWS:
          PHYSICAL DEVICE = 3390
          STORAGE CONTROLLER = 2107
          STORAGE CONTROL DESCRIPTOR = E8
          DEVICE DESCRIPTOR = 0A
```


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```
          ADDITIONAL DEVICE INFORMATION = 4800243D
          TRKS/CYL = 15, # PRIMARY CYLS = 3339
ICKO4030I DEVICE IS A PEER TO PEER REMOTE COPY VOLUME
ICKO2204I PPRCOPY DELPAIR FUNCTION COMPLETED SUCCESSFULLY
ICKO2230I DEVICE IS NOW IN SIMPLEX STATE
ICKOOOO1I FUNCTION COMPLETED, HIGHEST CONDITION CODE WAS 0
          09:36:00    06/16/05
```

26.7.6 Remove Global Copy paths

Finally, remove the Global Copy paths. Use the DDNAME parameter to point to the primary LSS, as shown in Example 26-43.

Example 26-43 Remove Global Copy paths with ICKDSF

```
//* ------------------------------------------------------------- ***
//DELPATH EXEC PGM=ICKDSF
//SYSPRINT  DD SYSOUT=*
//DDO1      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSIN     DD *

  PPRCOPY DDNAME(DDO1)  QUERY  PATHS

  PPRCOPY DDNAME(DDO1) DELPATH   -
          PRI(X'2060' AAGXA)     -
          SEC(X'0002' AAVCA)     -
          LSS(X'00' X'00')       -
          WWNN(500507630EFFFC6F  -
               500507630EFFFCA0)

  PPRCOPY DDNAME(DDO1)  QUERY  PATHS
/*
```

The path commands, delete path and establish path, require the WWNN of both storage disk subsystems. The PRI and SEC parameters include only two positional parameters: the SSID and the serial number of the corresponding storage disk subsystems.

26.8 Query device information with ICKDSF

Example 26-44 shows an ICKDSF example that queries all hardware-related device information, including all connected channel paths and their status.

Example 26-44 ICKDSF queries all device attributes

```
//* ------------------------------------------------------------- ***
//* ICKDSF ANALYZE                                                ***
//* ------------------------------------------------------------- ***
//ANALYZE EXEC PGM=ICKDSF
//* UNIT(XXXX) - OFFLINE / OTHERWISE DDNAME(...) WHEN ONLINE
//DDO1      DD UNIT=3390,VOL=SER=AA6000,DISP=SHR
//SYSPRINT  DD SYSOUT=*
//SYSIN     DD *
 ANALYZE DDNAME(DDO1) NODRIVE NOSCAN
/*
```

This is a useful command, especially when you are collecting detailed information in case of errors and problem reporting.

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26.9 Set up a Global Mirror environment using DS SM

You may establish a Global Mirror environment with the DS Storage Manager (DS SM) that provides a graphical user interface (GUI).

A Global Mirror session relies on the following components, which are independent of the interface used, but are repeated here in case you are only reading this section:

- Paths for Global Copy communication between primary and secondary LSSs. Paths may also be required for communication between Master and Subordinate LSSs, in case these LSSs reside on different primary storage disk subsystems.
- Global Copy pairs: primary A volumes and secondary B volumes.
- FlashCopy pairs, which are part of Global Mirror. These FlashCopy relationships are established at the secondary (remote) site between the B and C volumes. Note that the B volumes are not only the FlashCopy source, but they are also Global Copy secondaries at the same time. The C volumes are the FlashCopy target volumes.

Up to eight storage images can contribute their volumes to a Global Mirror session at the primary site. The same number applies for the secondary site.

Note: You will notice that in the present section we frequently use the terms *storage image*, *source*, and *target*, instead of the terms *storage disk subsystem*, *primary*, and *secondary*. Both sets of terms are similar, but here we use the first one to be more in accordance with the terminology that you find in the DS Storage Manager panels.

The creation of a Global Mirror session requires that you perform the following steps:

1. Create paths.
   a. Between the source LSSs on the source Storage Images on site 1, and the target LSSs on the target Storage Images on site 2.
   b. Within site 1, between the Master storage image LSS, or for short Master, and the Subordinate storage image LSSs. This task is not required if you have only one source storage image. In this case, all communication between Master and Subordinate LSSs is managed internally and does not need your attention.
2. Create Global Copy pairs with source volumes on site 1 and target volumes on site 2.
3. Create FlashCopy pairs on site 2, between the Global Copy target volumes that at the same time are FlashCopy source volumes, and their corresponding target volumes.
4. Define the common Global Mirror session to each LSS, on the source Storage Images at site 1, that are going to be part of this Global Mirror environment.
5. Create a Global Mirror session relationship between the Global Mirror Master and its Subordinates.

Now the session can be started, so that the process of Consistency Groups formation begins.

The following sections show how to perform the necessary activities for the setup of a Global Mirror environment when using the DS Storage Manager GUI.

Note: The DS SM examples that we present in this section were run in a DS8000 HMC, but are basically similar to what you see in a DS6000 SMC when using the DS SM GUI.

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26.9.1 Create paths

When using the DS Storage Manager to create paths between two LSSs on two different Storage Images, it is necessary to go through a six-step process creation wizard. This wizard needs to be repeated for each data path to be defined. Remember that you have to define paths between site 1 and site 2, for Global Copy replication, and eventually you will also have to define paths within site 1 if the Master and Subordinates are on different Storage images.

To launch this wizard, first you need to go to the Paths panel under the Copy Services menu of the DS Storage Manager GUI. In the Select Action pull-down list, choose **Create** to proceed with the first step of the wizard. See Figure 26-8.

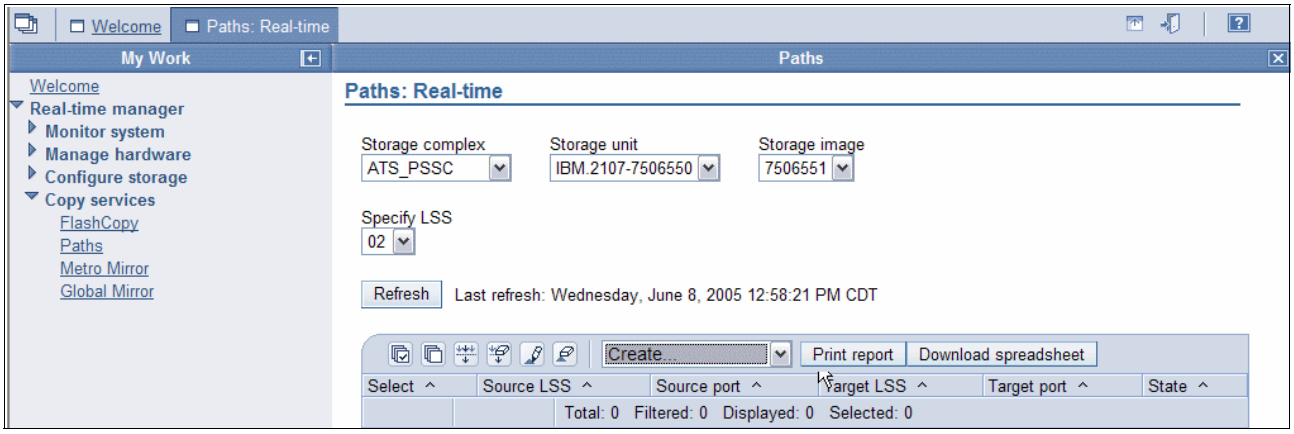

Figure 26-8 Global Copy paths creation - launch the definition process

The creation wizard then displays the “Select source LSS” panel; see Figure 26-9. Here you select from the pull-down lists the **Storage complex**, then the **Storage unit**, then the **Storage Image**, and finally the **LSS** that contains the source volumes of the Global Copy pairs. These are the volumes that are going to be members of the Global Mirror session.

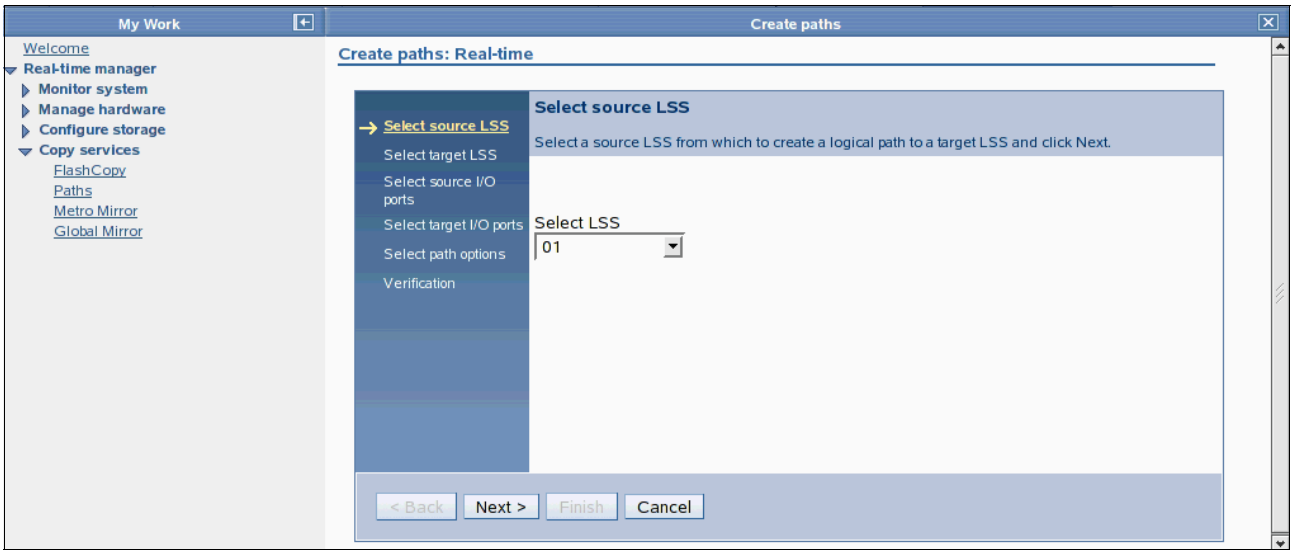

Figure 26-9 Global Copy paths creation step 1 - select the source LSS

Click **Next** to proceed with the second step of this wizard.

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The creation wizard then displays the “Select target LSS” panel; see Figure 26-10. Here you select from the pull-down lists the **Storage complex**, then the **Storage unit**, then the **Storage Image** and finally the **LSS**, which contains the corresponding target volumes of the Global Copy pairs. Click **Next** to proceed with the third step of this wizard.

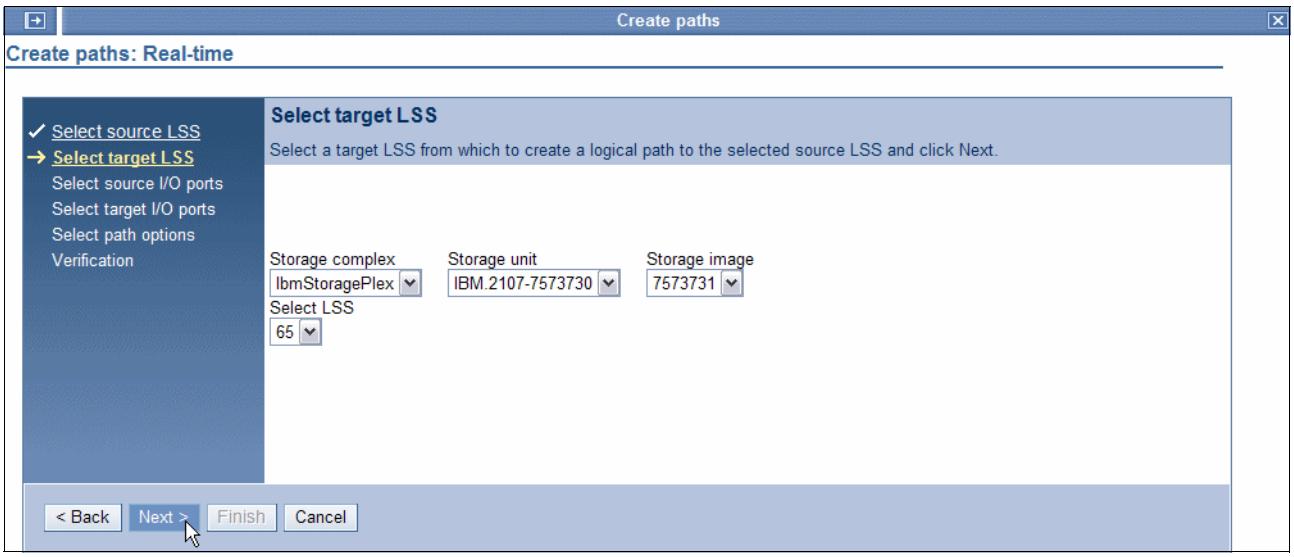

Figure 26-10 Global Copy paths creation step 2 - select the target LSS

Then the creation wizard displays the “Select source I/O ports” panel; see Figure 26-11. Here you select, with the check boxes, the I/O ports through which you intend to connect the source LSS to the target LSS. In the location column, four digits indicate the location of a port:

- The first digit - `R` - is to locate the frame.
- The second digit - `E` - is for the I/O enclosure.
- The third digit - `C` - is for the adapter.
- The fourth digit - `P` - is for the adapter port.

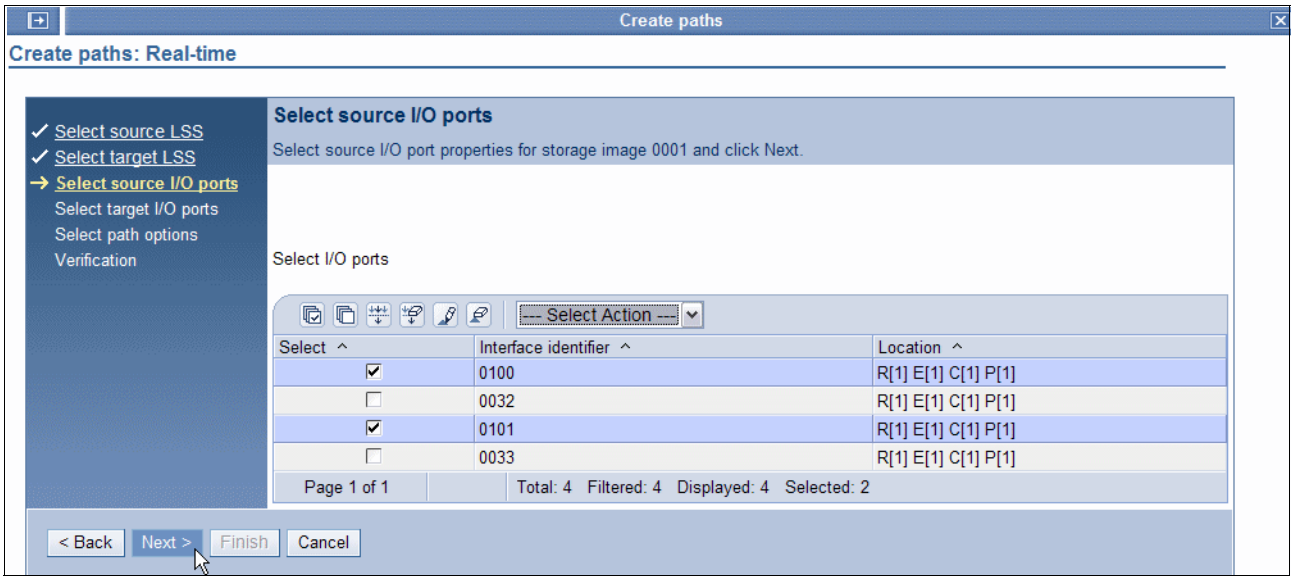

Figure 26-11 Global Copy paths creation step 3 - select the source I/O ports

Click **Next** to proceed with the fourth step of this wizard.

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Then the creation wizard displays the **Select target I/Os ports** panel; see Figure 26-12. Here you select from the pull-down list the target I/O ports that you intend to connect with the source I/O ports.

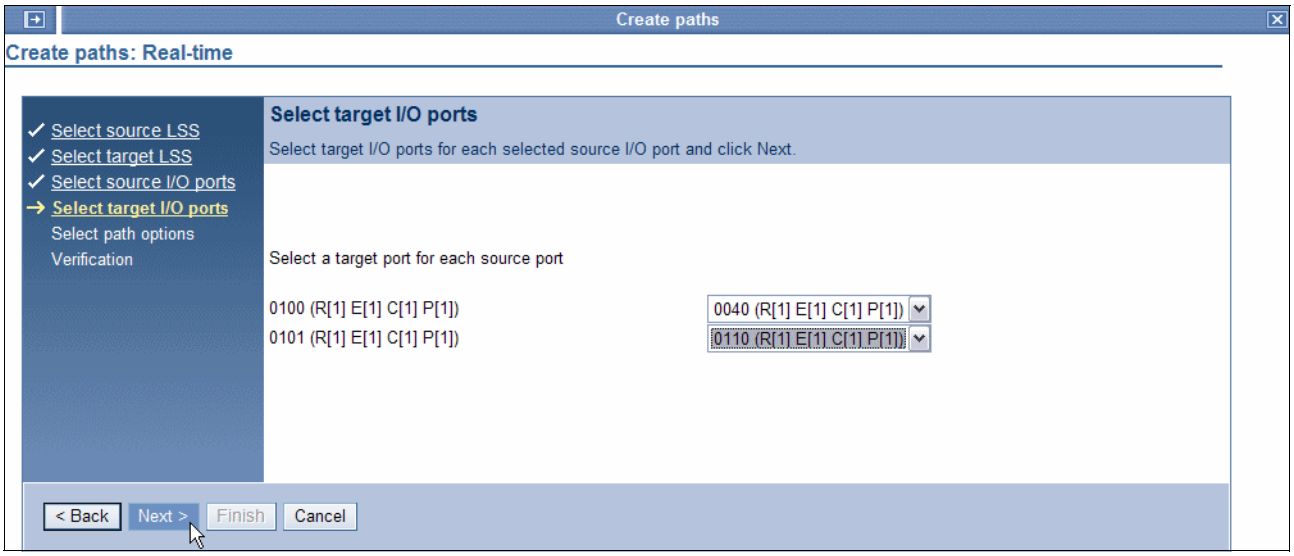

Figure 26-12 Global Copy paths creation step 4 - select the target I/O ports

Click **Next** to proceed with the next step of this wizard.

Then the creation wizard displays the “Select path options” panel; see Figure 26-13. Here you have a box that can be checked for the option **Define as Consistency Group**.

This option is used in the context of Metro Mirror only. Global Mirror manages consistency by its own design, and provides a consistent set of volumes at the remote site without relying on this option.

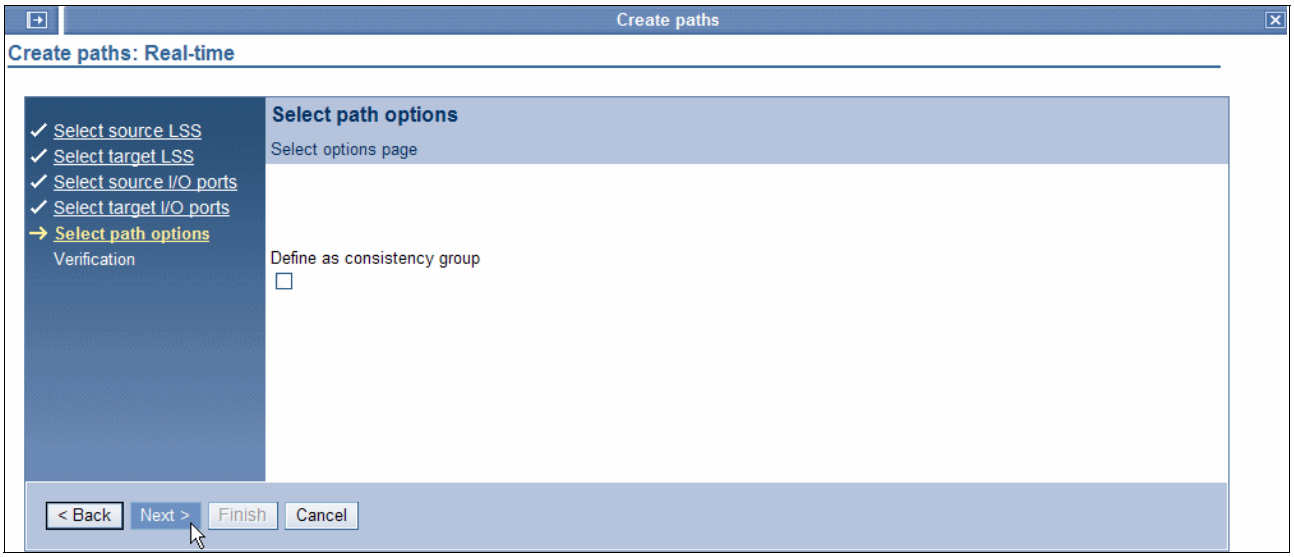

Figure 26-13 Global Copy path creation step 5 - select the path options

Click **Next** to proceed with the sixth and last step of this wizard.

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This brings you to the Verification panel; see Figure 26-14. Here you can check all the components of your path definitions and, if necessary, click **Back** to correct any of them, or click **Finish** to validate the configuration and end the wizard.

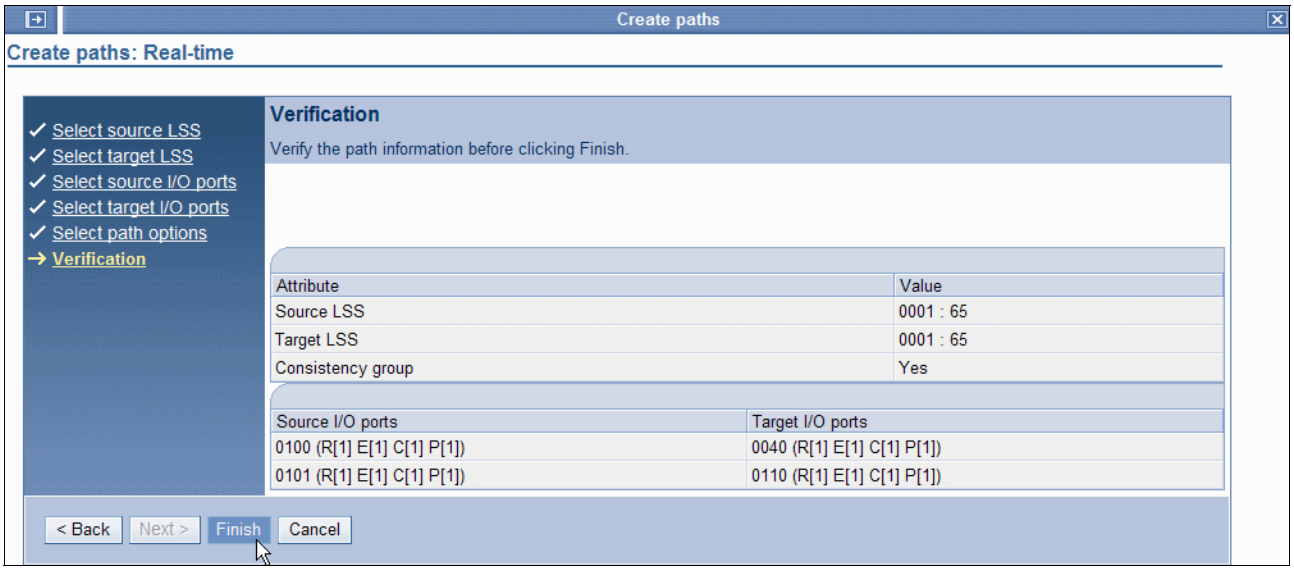

Figure 26-14 Global Copy path creation step 6 - verification

26.9.2 Create Global Copy volume pairs

To create Global Copy volume pairs for a Global Mirror session, using the DS Storage Manager, you have to go through another staged process with corresponding panels. This procedure is demonstrated in this section.

Note: If Global Copy pairs are in several LSSs in the same storage image, do not forget to select all of them during this wizard. Else, you will have to run the wizard again for each LSS. If the Global Copy pairs are spread over several Storage images, then you will have to run this wizard again for each of them.

To launch this wizard you need first to go to the Metro Mirror panel, under the Copy Services menu of DS Storage Manager GUI. In the Select Action pull-down list, choose **Create** to proceed with the first step of the wizard. See Figure 26-15.

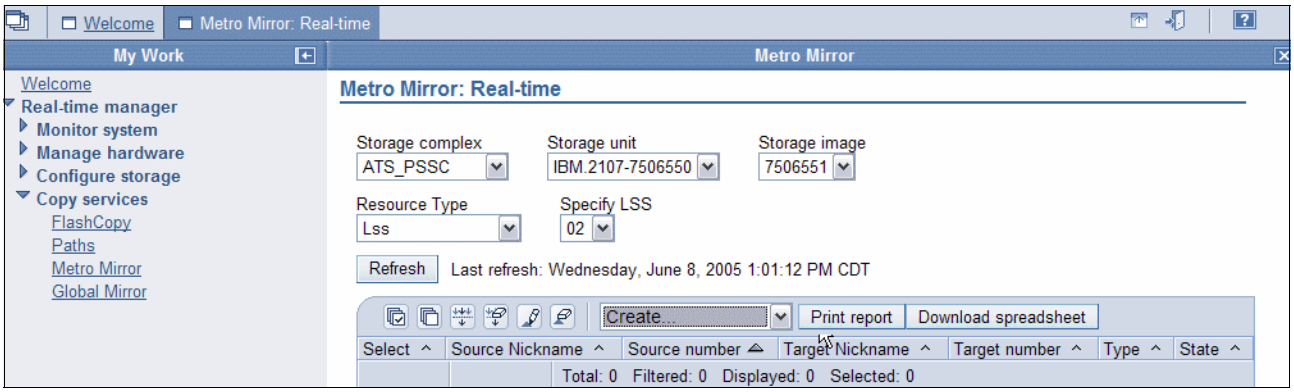

Figure 26-15 Global Copy creation - launch the creation process

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Then the creation wizard displays the Volume Pairing Method panel; see Figure 26-16. Here you select **Manual volume pair assignment**.

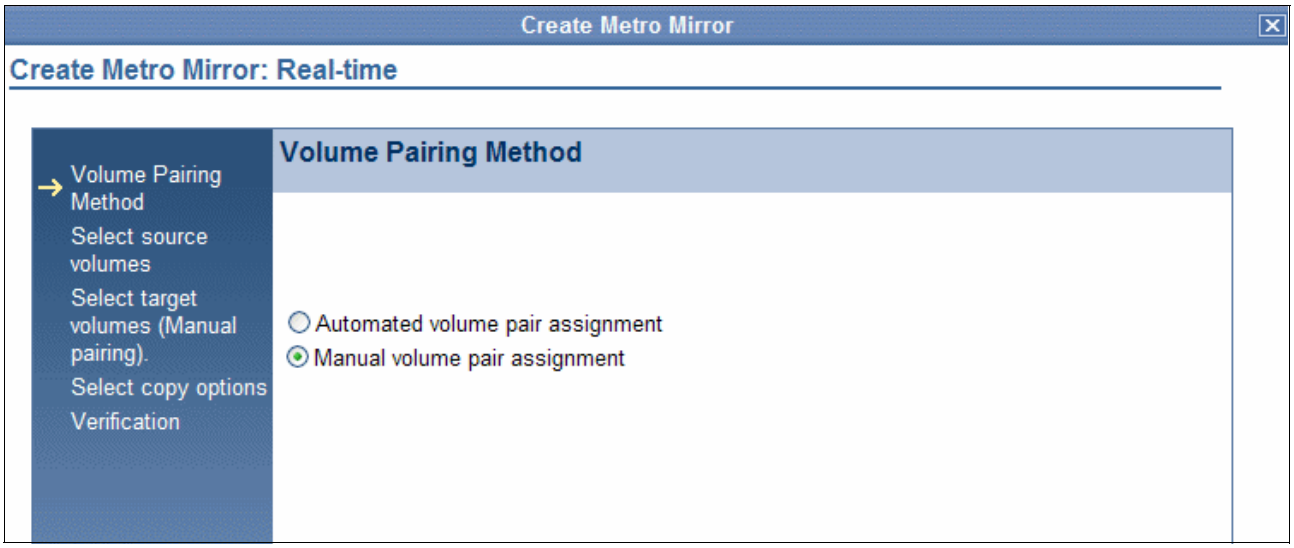

Figure 26-16 Global Copy creation step 1 - choose volume pairing method

Click **Next** to proceed with the second step of this wizard.

Then the creation wizard displays the “Select source volumes” panel; see Figure 26-17.

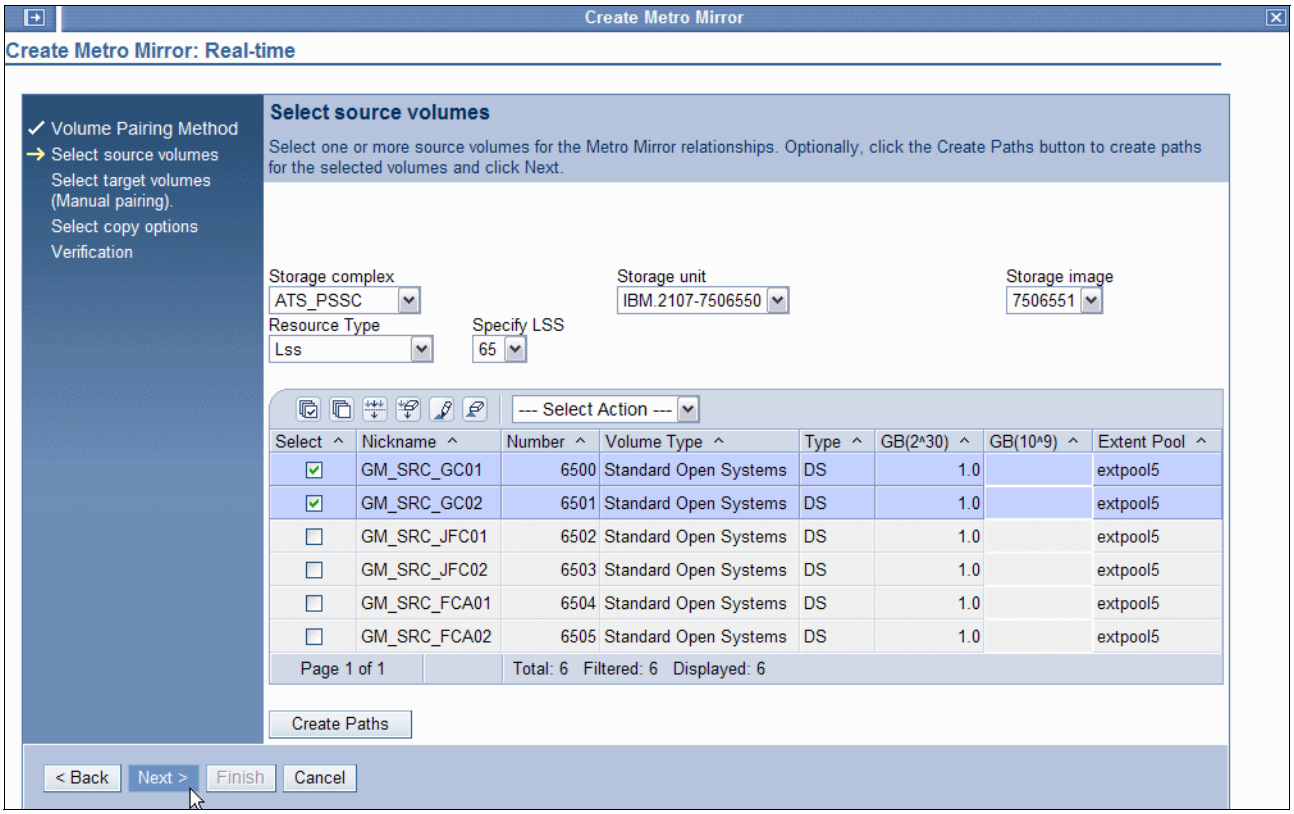

Figure 26-17 Global Copy creation step 2 - select the source volumes

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In the “Select source volumes” panel (see Figure 26-17), select from the pull-down lists the **Storage complex**, then the **Storage unit**, then the **Storage Image**, then the **Resource type** and, if necessary, its appropriate parameter to display the list of volumes. If you have chosen the **Resource type** LSS, select from the pull-down list the LSS number that contains the source volumes you intend to use. Then, check the boxes for the source volumes you plan to use as Global Copy pairs in the Global Mirror session. Click **Next** to proceed with the third step of this wizard.

Note: If paths have not been created yet, you can click **Create Paths** to launch the wizard to create paths as described in the previous section.

Then the creation wizard displays the “Select target volumes” panel; see Figure 26-18.

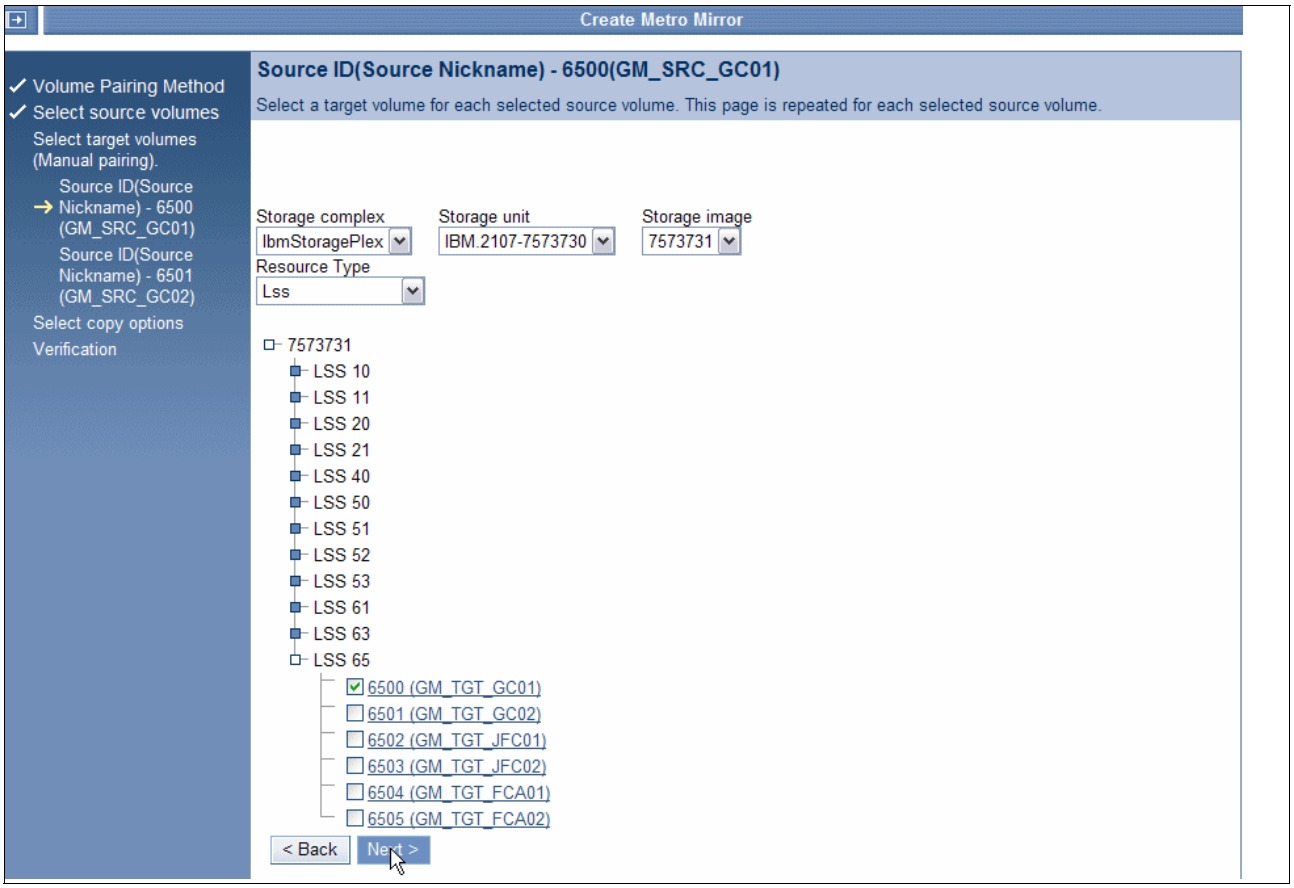

Figure 26-18 Global Copy creation step 3 - select the target volume 1

Note: Although the following panels refer not to CKD volumes but to open systems volumes, it applies in the very same fashion to CKD volumes.

In this panel (see Figure 26-18), we notice that only one source volume is indicated on the top of the panel. It means that we need to repeat this third step for each volume we have selected during the previous second step.

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Select from the pull-down lists the **Storage complex**, then the **Storage unit**, then the **Storage Image**, then the **Resource type** and, if necessary, its appropriate parameter to display the list of volumes. Click the required Storage Unit, then on the required LSS check the box for the volume you want to use as target.

Click **Next** to proceed with the selection of the second target volume.

Again the “Select target volumes” panel is displayed. Now, you may notice that only the indicated source volume on the top of the panel is different; see Figure 26-19.

Once again, select from the pull-down lists the **Storage complex**, then the **Storage unit**, then the **Storage Image**, then the **Resource type** and, if necessary, its appropriate parameter to display the list of volumes.

Click the required Storage Unit, then click the required LSS, and check the box for the volume you plan to use as the Global Copy target. If you had selected more source volumes, you would once again proceed to the next target volume selection panel. In our example, this is the second and last volume in our selection.

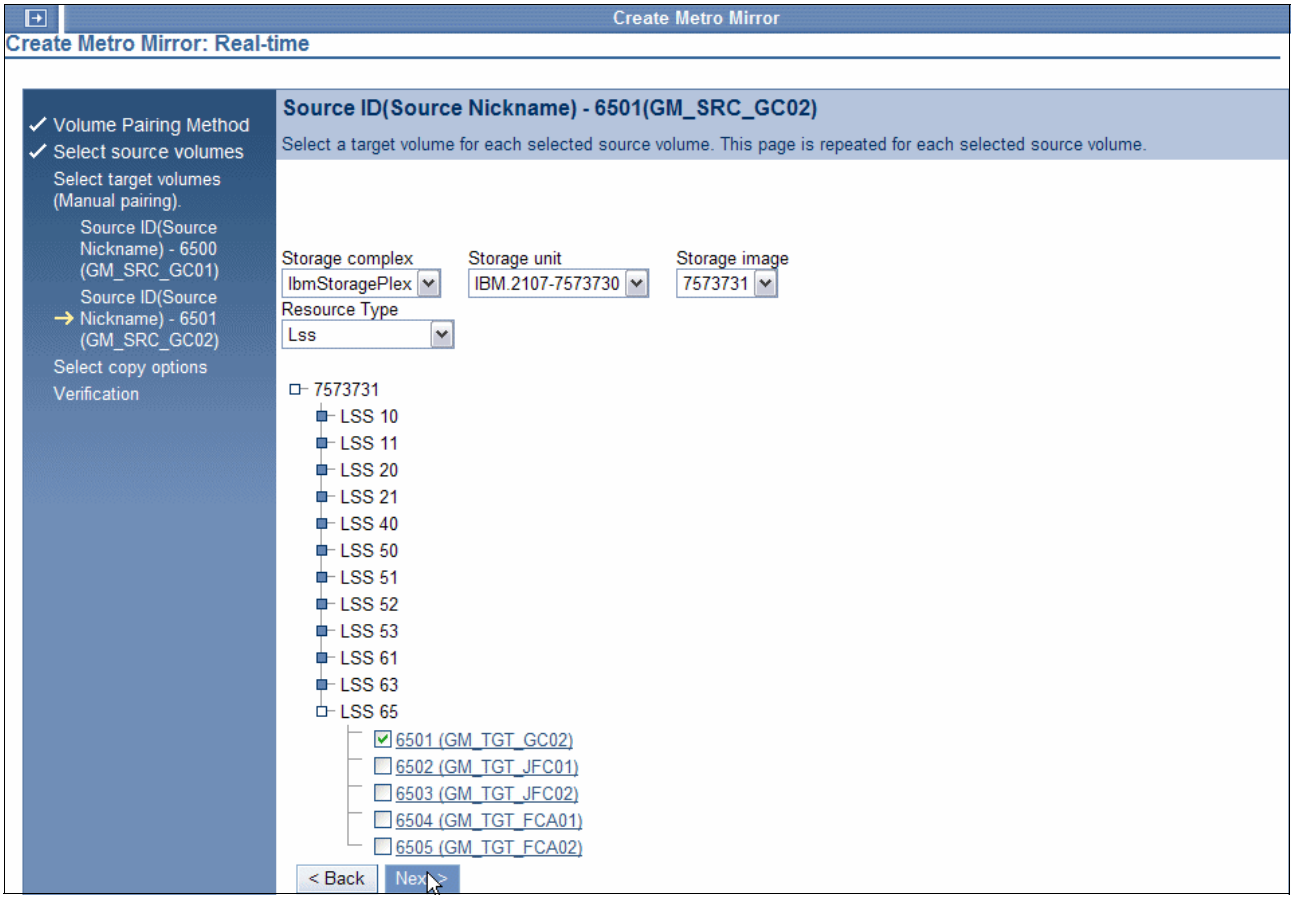

Figure 26-19 Global Copy creation step 3 - select the target volume 2

Click **Next** to proceed with the fourth step of this wizard.

When the creation wizard displays the “Select copy options” panel (see Figure 26-20 on page 381), select **Global Copy** to define the type of replication relationship. If this is the first synchronization between source and target volumes of these pairs, check the box for **Perform initial copy**.

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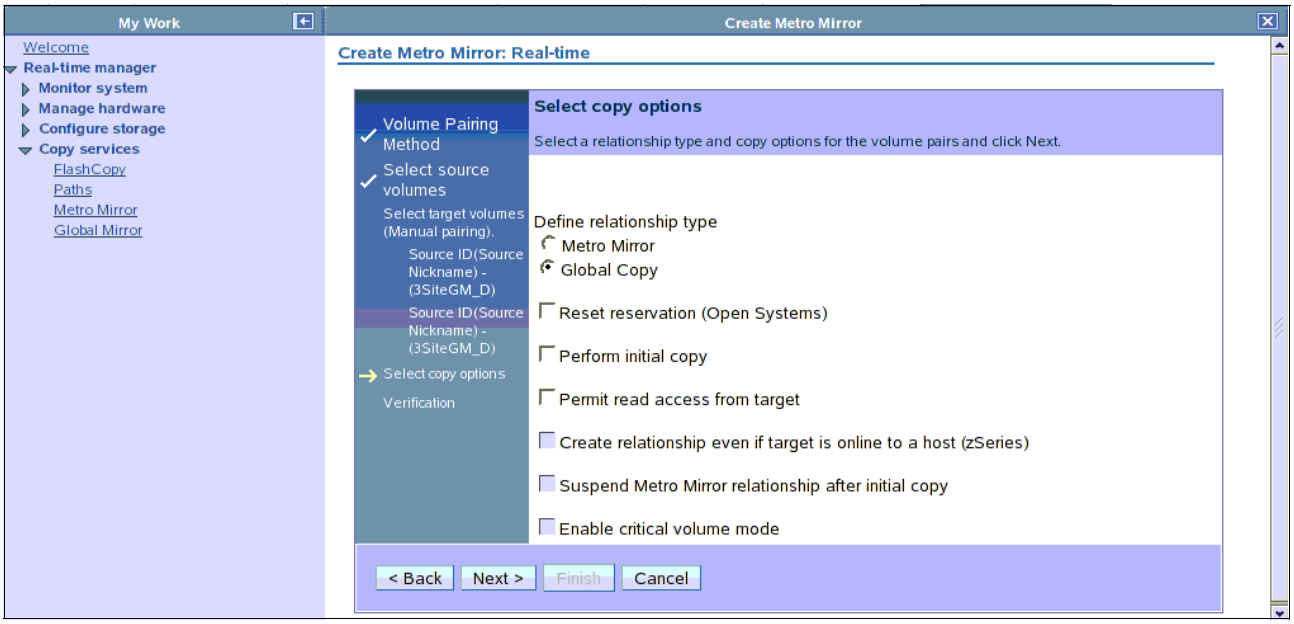

Figure 26-20 Global Copy creation step 4 - select the copy options

Click **Next** to proceed with the last step of this wizard.

The Verification panel is displayed; see Figure 26-21. In this panel check all the components of your Global Copy session configuration, and, if necessary, click **Back** to correct any of them, or click **Finish** to validate. In Figure 26-20 you may move back to correct the **Permit read access from target**.

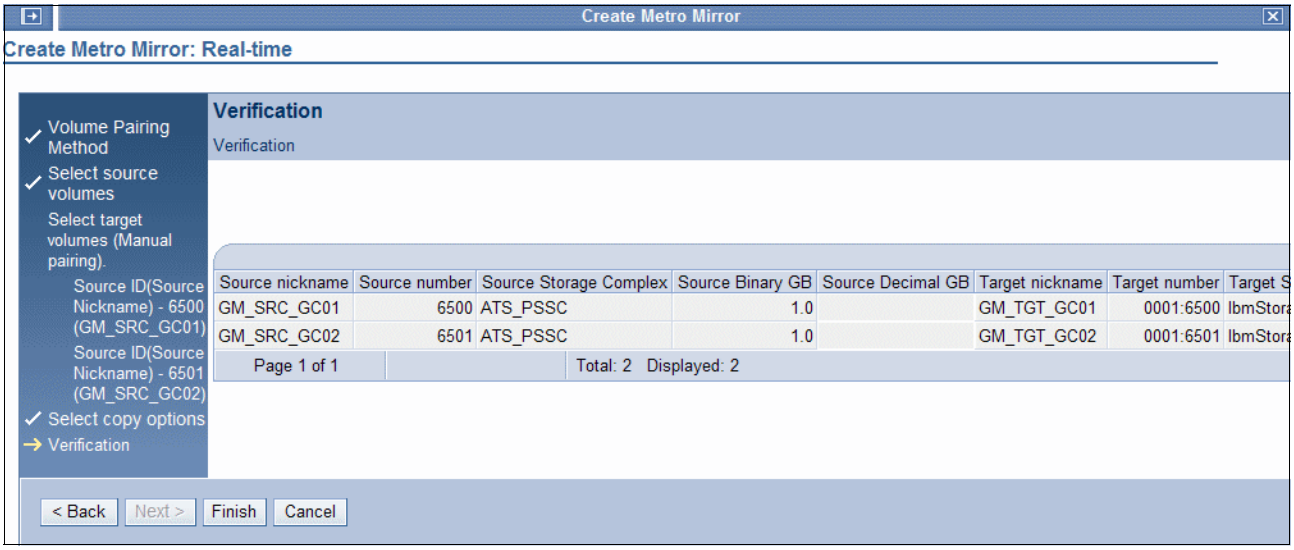

Figure 26-21 Global Copy creation step 5 - verification

26.9.3 Establish FlashCopy relationships

To create FlashCopy pairs with the DS Storage Manager, you have to work through another series of steps and GUI panels.

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To launch this wizard, you need to first go to the FlashCopy panel under the Copy Services menu of DS Storage Manager GUI; see Figure 26-22. In the Select Action pull-down list choose **Create** to proceed with the first step of the wizard.

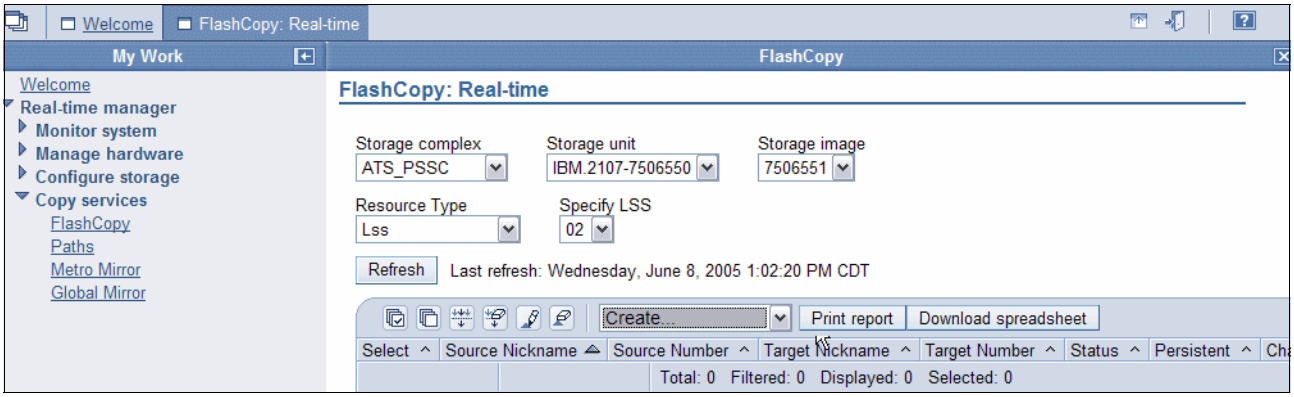

Figure 26-22 FlashCopy creation - launch the creation process

Note: If FlashCopy pairs are in several LSSs, do not forget to select all of them during this wizard, or run the wizard again on each LSS. If FlashCopy pairs are spread over several Storage Images, run this wizard again on each of them.

Now the creation wizard displays the “Define relationship type” panel; see Figure 26-23. Here you select **A single source with a single target,** because we must activate the *record* option on the fourth step of this wizard.

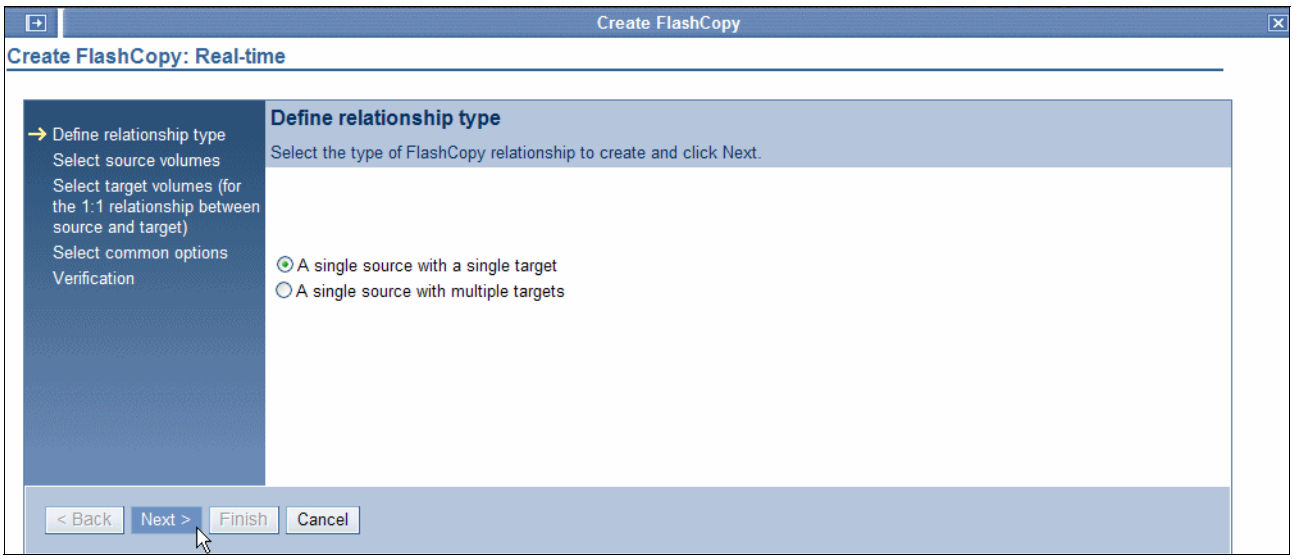
Create FlashCopy
Create FlashCopy: Real-time
Define relationship type
Select source volumes
Select target volumes (for the 1:1 relationship between source and target)
Select common options
Verification
Define relationship type
Select the type of FlashCopy relationship to create and click Next.
A single source with a single target
A single source with multiple targets
< Back
Next >
Finish
Cancel

Figure 26-23 FlashCopy creation step 1 - select the relationship type

Click **Next** to proceed to the second step of this wizard.

Now the creation wizard displays the “Select source volumes” panel; see Figure 26-24 on page 383. Here you select from the pull-down lists the **Storage complex**, then the **Storage unit**, then the **Storage Image**, then the **Resource type** and, if necessary, its appropriate parameter to display the list of volumes. If you have chosen the **Resource type** LSS, then select from the pull-down lists the LSS number that contains the source volumes you want to

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use. Select with the check boxes the source **volumes** you plan to use for FlashCopy within the Global Mirror session.

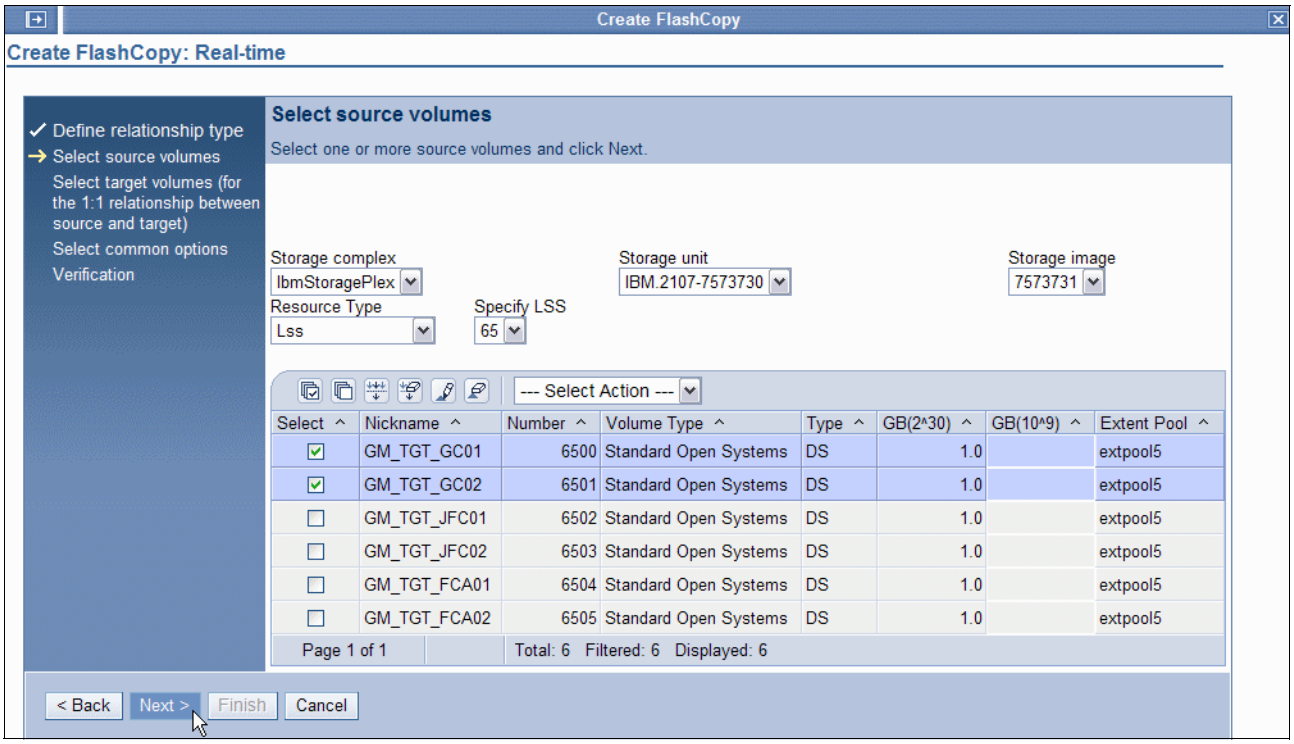

Figure 26-24 FlashCopy creation step 2 - select the source volumes

Note: Although the following panels show open systems volumes, the panels and their order apply also to CKD volumes.

Click **Next** to proceed with the third step of this wizard. The creation wizard then displays the “Select target volumes” panel; see Figure 26-25.

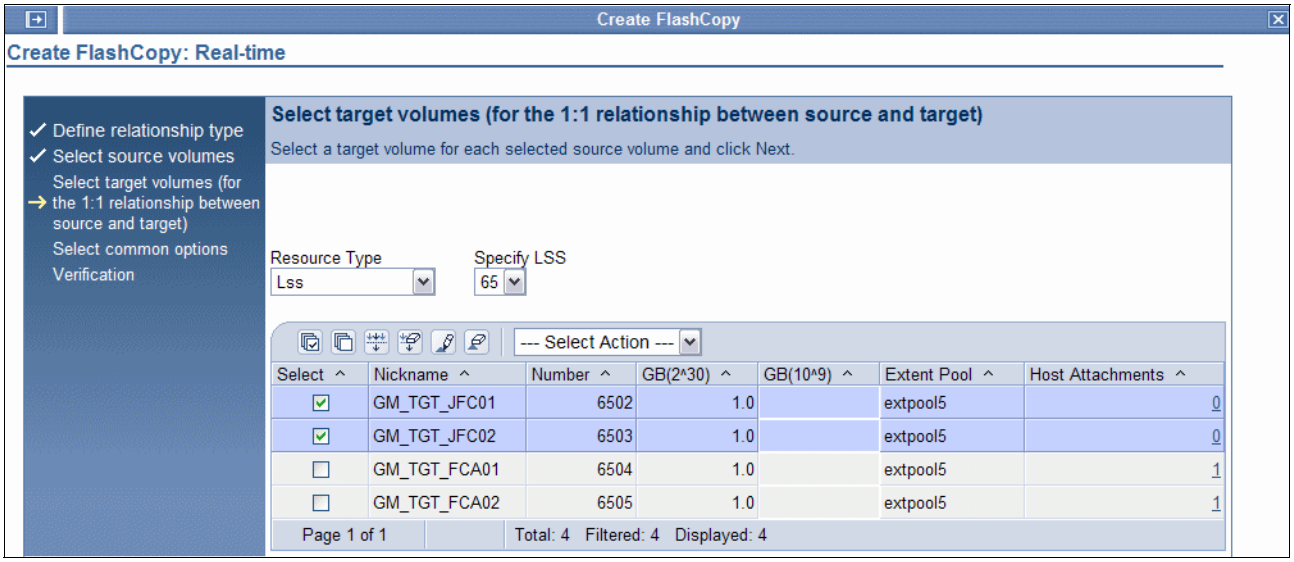

Figure 26-25 FlashCopy creation step 3 - select the target volumes

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When the creation wizard displays the “Select target volumes” panel (see Figure 26-25), select from the pull-down lists the **Resource type** and if necessary its appropriate parameter to display the list of volumes. If you have chosen the **Resource type** LSS, select from the pull-down lists the LSS number that contains the target volumes you plan to use. Check the boxes of the volumes you want to use as target FlashCopy volumes.

Click **Next** to proceed with the fourth step of this wizard. The creation wizard then displays the “Select common options” panel; see Figure 26-26.

In this panel, check the box for **Enable change recording**. This should also automatically check the box for **Make relationship(s) persistent**. You can leave the *Sequence number for these relationships field with its default value, since Global Mirror will take care of it automatically.

Note: Do *not* select the check box for **Initiate background copy**.

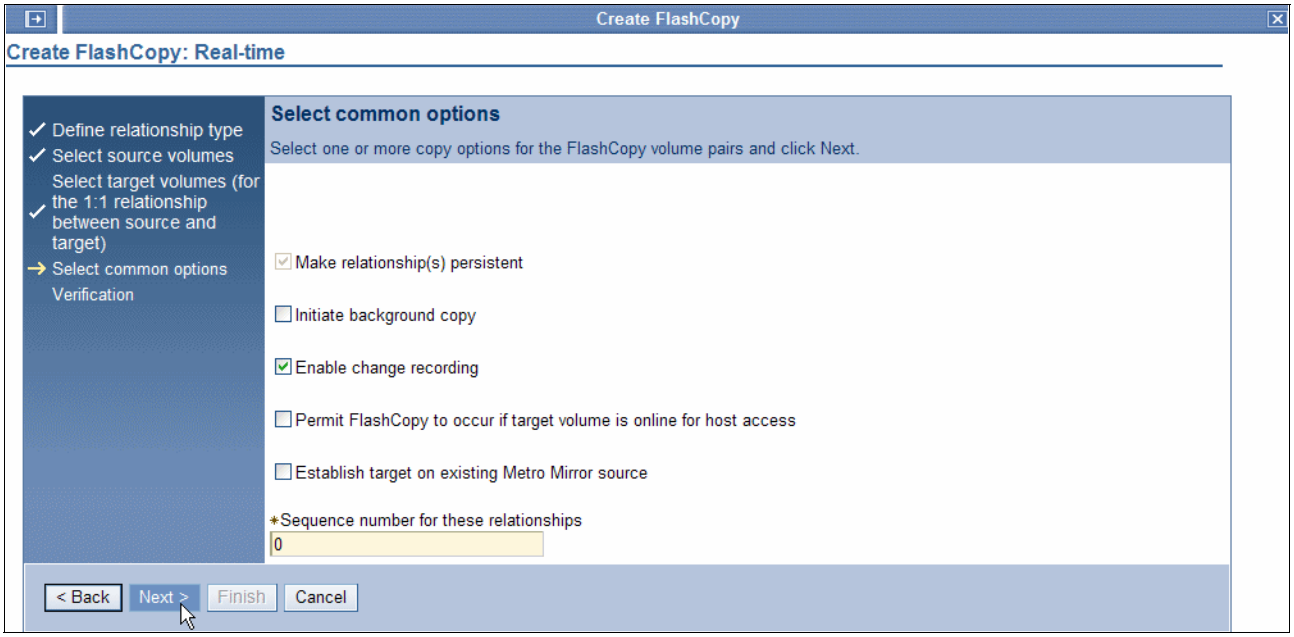
Create FlashCopy
Create FlashCopy: Real-time
Define relationship type
Select source volumes
Select target volumes (for the 1:1 relationship between source and target)
Select common options
Verification
Select common options
Select one or more copy options for the FlashCopy volume pairs and click Next.
Make relationship(s) persistent
Initiate background copy
Enable change recording
Permit FlashCopy to occur if target volume is online for host access
Establish target on existing Metro Mirror source
*Sequence number for these relationships
0
< Back
Next >
Finish
Cancel

Figure 26-26 FlashCopy creation step 4 - select the common option

Click **Next** to proceed with last step of this wizard.

The creation wizard then displays the Verification panel; see Figure 26-27 on page 385.

In this panel check all the components of your FlashCopy session definitions and if necessary, click **Back** to correct any of them, or click **Finish** to validate.

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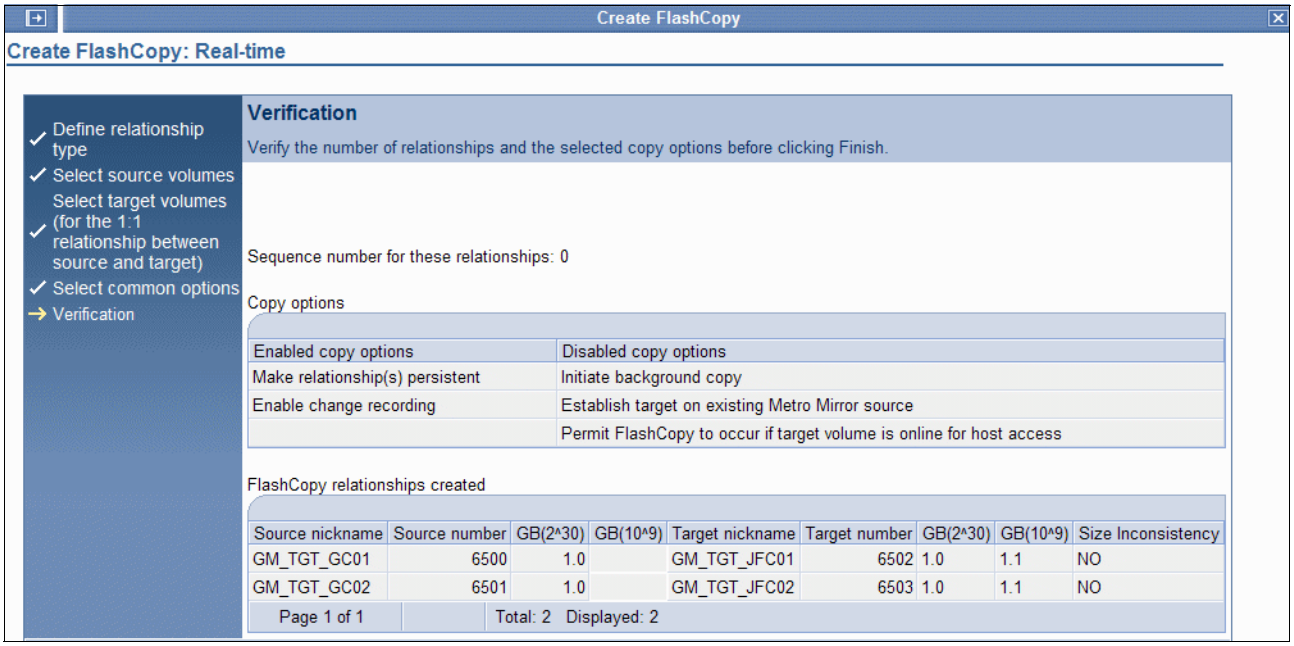

Figure 26-27 FlashCopy creation step 5 - verification

26.9.4 Create a Global Mirror session

To define a Global Mirror session with the DS Storage Manager, you go through another staged panel process.

To launch this wizard you first need to go to the Global Mirror panel under the Copy Services menu of DS Storage Manager GUI; see Figure 26-28. In the Select Action pull-down list, choose **Create** to proceed with the first step of the wizard.

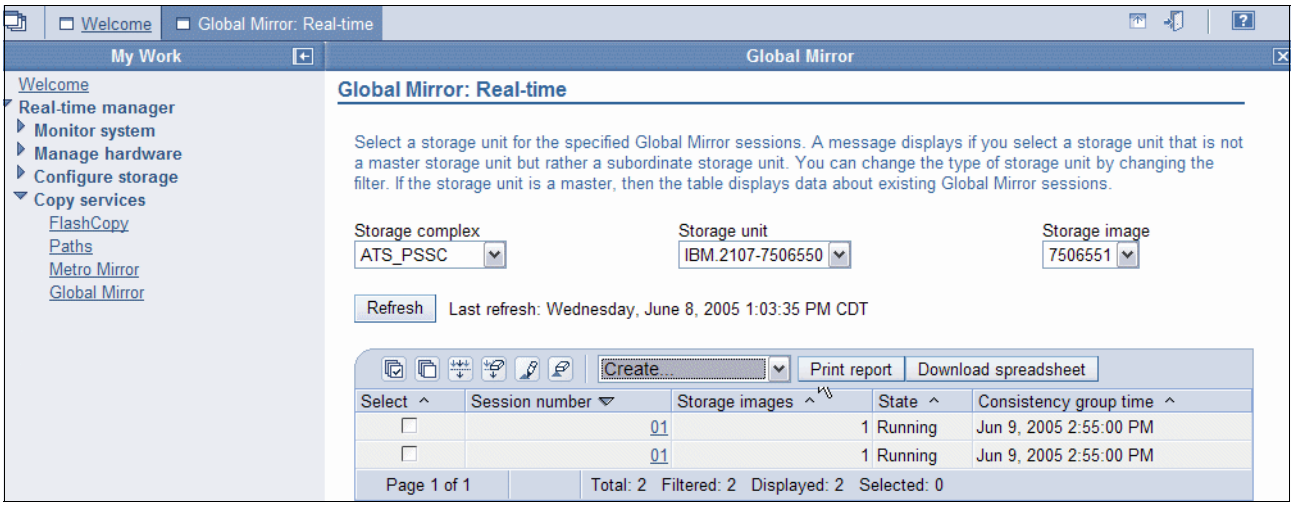

Figure 26-28 Global Mirror creation - launch the creation process

Then the creation wizard displays the “Select volumes” panel; see Figure 26-29 on page 386. In this panel you click the required **Storage Unit**, then the required **LSS**, and then check the box for the source volumes that you want to include in the Global Mirror session.

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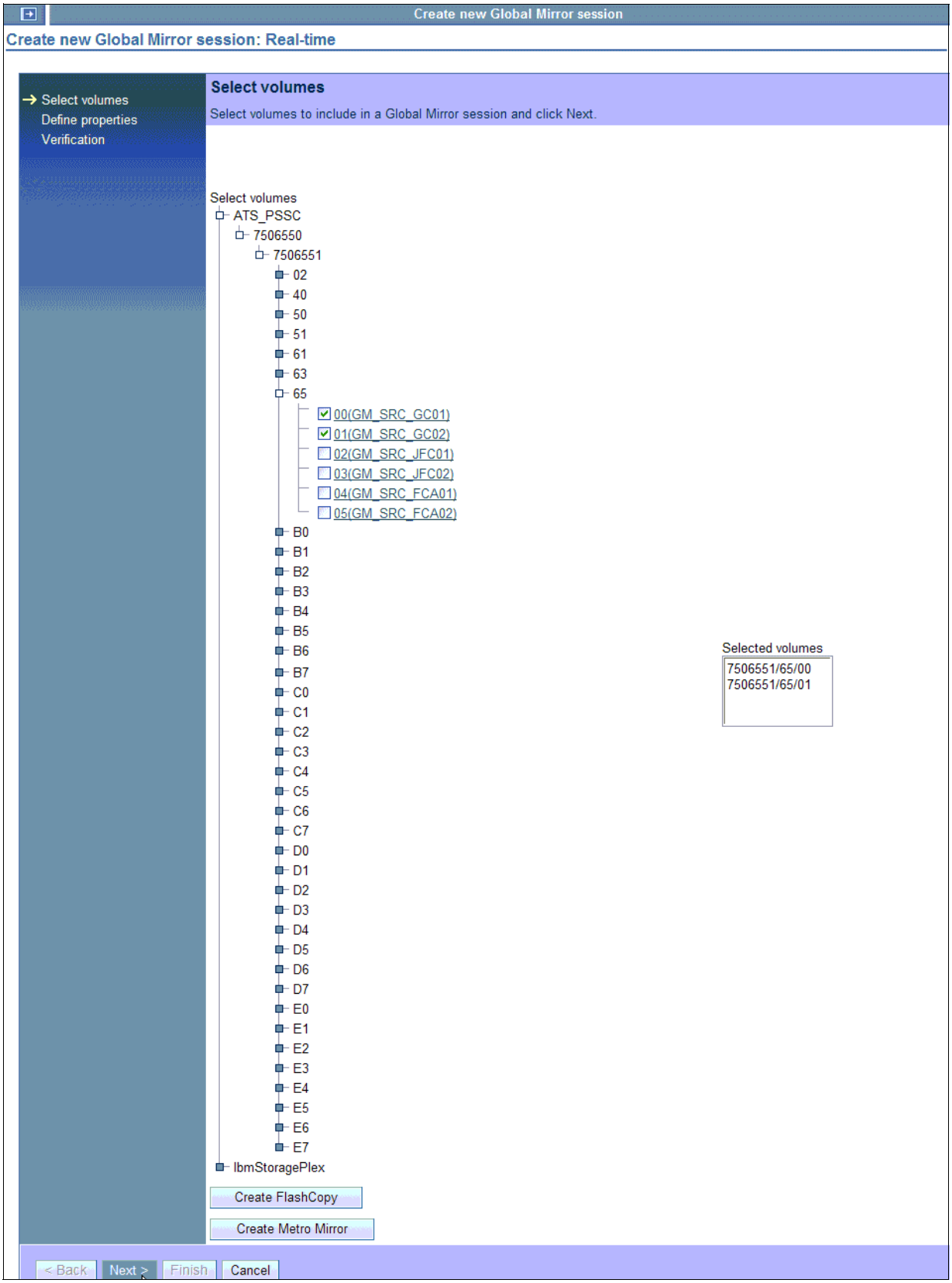

Figure 26-29 Global Mirror session creation step 1 - select volumes

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Click **Next** to proceed with the second step of this wizard. The creation wizard then displays the “Define properties” panel; see Figure 26-30.

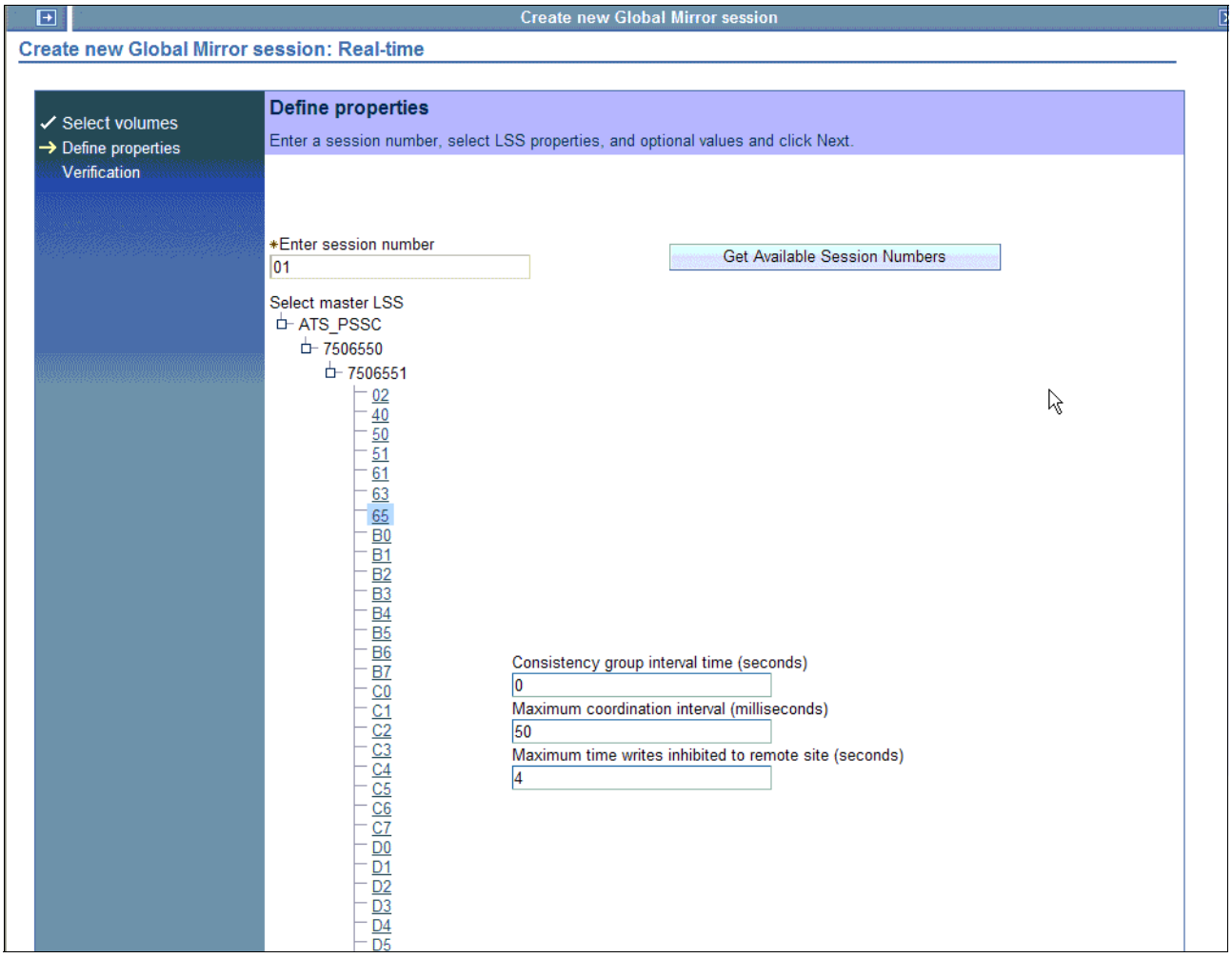

Figure 26-30 Global Mirror creation step 2 - define properties

When the creation wizard displays this panel, complete the “Enter session number” field with the appropriate session number. You can click **Get Available Session Numbers** if you have forgotten the one you want to use. In the panel there are also these three Global Mirror tuning parameters that can be set at this time:

- Consistency Group interval time
  Specifies, in seconds, how long to wait between the formation of Consistency Groups. If this number is not specified or is set to zero, Consistency Groups are formed continuously. The maximum is 18 hours.
- Maximum coordination interval
  Indicates, in milliseconds (ms), the maximum time allowed for the Master to coordinate a consistent data point with the Subordinates. During this time Global Mirror holds back host I/Os, to start forming a Consistency Group.
- Maximum time writes inhibited to remote site
  Specifies in seconds the maximum Consistency Group drain time for the replication of the remaining data from the primary site to the secondary site. This is the data that is still in the out-of-sync bitmap in the primary storage disk subsystem, waiting to be replicated to the secondary storage disk subsystem.

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When Global Mirror cannot complete replicating all outstanding data within this time window, then the process to form a new Consistency Group fails. After five contiguous failures due to this condition, Global Mirror will force the formation of a new Consistency Group independent of how long it takes to replicate all remaining data from the primary to secondary volumes. See also 22.4, “Consistency Groups” on page 260.

Click **Next** to proceed with the third and last step of this wizard. The creation wizard then displays the Verification panel; see Figure 26-31.

In this panel, verify all the components of your Global Mirror session configuration and, if necessary, click **Back** to correct any of them, or click **Finish** to validate.

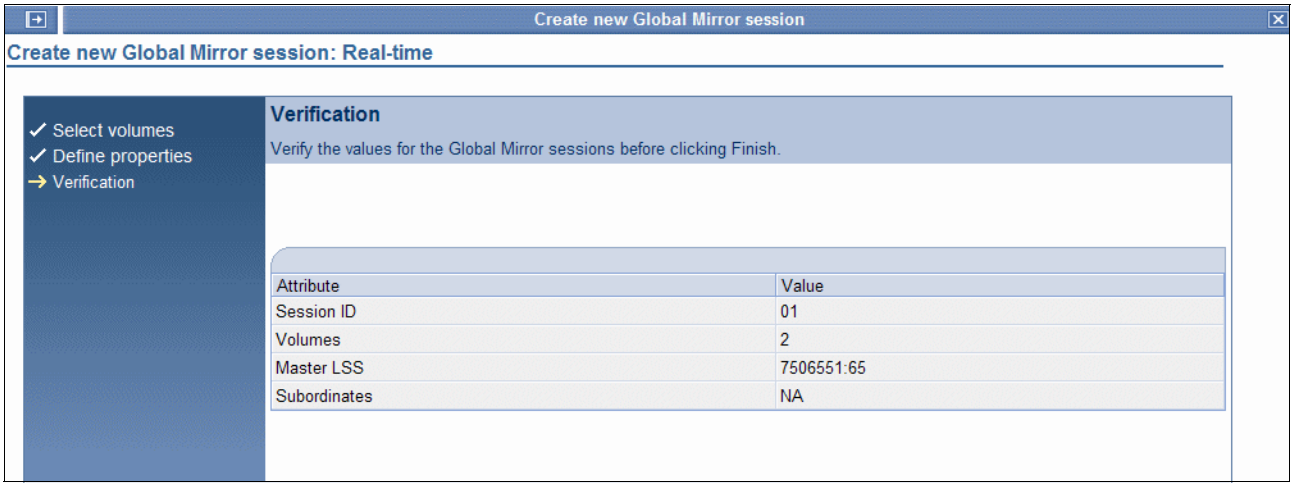

Figure 26-31 Global Mirror creation step 3 - verification

To visualize the status of the Global Mirror session, go to the Global Mirror panel under the Copy Services menu of DS Storage Manager GUI. Select from the pull-down lists the **Storage complex**, then the **Storage unit**, then the **Storage Image**, which is the Master Global Mirror session, and wait until the screen is refreshed. If it is necessary, click **Refresh** to refresh the panel. See Figure 26-32.

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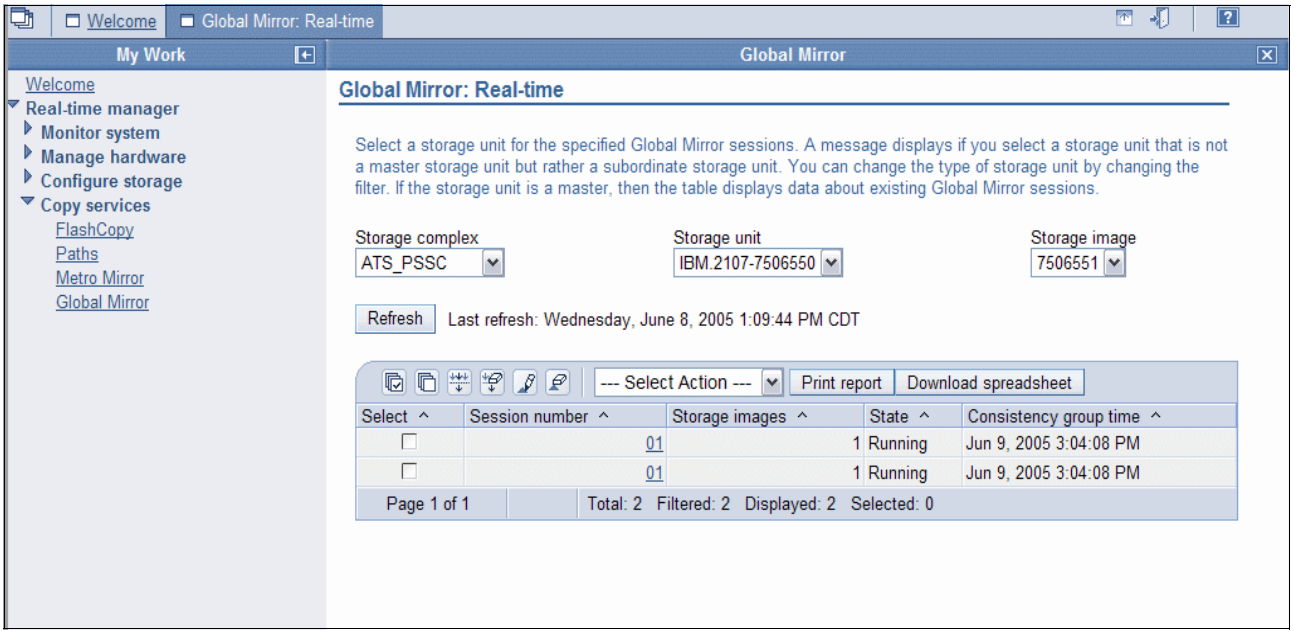

Figure 26-32 Global Mirror - visualize the session status

26.10 Set up a Global Mirror environment using the DS CLI

You may consider implementing a standard task such as creating a Global Mirror session, through a more automated process than the DS SM graphical interface approach. The DS CLI provides a good approach, which is similar to what you may do with REXX procedures, or other software-based tools in System z environments, to assist when managing remote copy configurations.

The DS Storage Manager GUI has its value in a situation when, for example, you have to react somehow ad hoc. The DS SM GUI also has some advantage over the DS CLI when you need to retrieve information from certain storage images, which may not be so easy to understand through the DS CLI if you are not accustomed to working with it.

The following sections show how to perform the necessary activities for the setup of a Global Mirror environment using the DS Command-Line Interface.

Note: The example presented in this section was run on a DS8000. The same process and commands are applicable to a DS6000 configuration.

The components that have to be defined, as well as the procedure to be followed, to set up a Global Mirror environment are the same, independent of the management interface that is used. At the beginning of 26.9, “Set up a Global Mirror environment using DS SM” on page 373, those topics are discussed.

Note: You will notice that here we frequently use the terms *storage image*, *source*, and *target*, instead of the terms *storage disk subsystem*, *primary*, and *secondary*. These sets of terms are similar, but here we use the first one to be more in accordance with the terminology that you find in the DS CLI commands.

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26.10.1 DS CLI profile files

To simplify DS CLI commands, we use configuration files.

Example 26-45 and Example 26-46 show the configuration files that we are using in our environment. These profiles are stored in the default directory c:\Program Files\IBM\dscli\Profile for Windows systems.

Because we are using two storage disk subsystems, and there is a local entry and a remote entry in these files indicated by devid and remotedevid, we created two profile files. Each file has a local and a remote device ID with the corresponding storage disk subsystem serial numbers.

Example 26-45 Sample DS CLI configuration file DS-01.profile

```
hmc1: xxx.yyy.zzz.xxx
username: admin
password: passw0rd
devid:IBM.2107-7506551
remotedevid:IBM.2107-7573731
fullid: off
banner: on
verbose: off
paging: off
olc: off
```


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Example 26-46 Sample DS CLI configuration file DS-02.profile

```
hmc1: xxx.yyy.zzz.yyy
username: admin
password: passw0rd
devid:IBM.2107-7573731
remotedevid:IBM.2107-7506551
fullid: off
banner: on
verbose: off
paging: off
olc:off
```

26.10.2 Create paths

When using the DS CLI to create new paths from a source LSS to a target LSS, use the procedure we discuss here. This process must be repeated for every path you need to define. Remember that you have to define paths between site 1 and site 2, for Global Copy replication, and eventually you will also have to define paths within site 1 if the Master and Subordinates are on different storage disk subsystems.

The first step in this procedure is to find out which I/O ports are available for the definition of Global Copy paths between the source and the target LSSs. For this, use the following command:

```
dscli lsavailpprcport -remotewwnn <WWN of your remote Storage Image>
<Source_LSS_ID>:<Target_LSS_ID> -cfg <Source device configuration file>
```

Example 26-47 shows the command and the corresponding output information: a list of available ports from the source LSS 65 in the storage disk subsystem at site 1, to the target LSS 65 in the storage disk subsystem at site 2.

Example 26-47 lsavailpprcport

```
dscli lsavailpprcpport -remotewwnn 5005076303FFC426 65:65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 6:18:16 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
Local Port Attached Port Type
============================
I0100      I0040         FCP
I0101      I0040         FCP
I0100      I0110         FCP
I0101      I0110         FCP
I0032      I0240         FCP
I0033      I0240         FCP
I0032      I0310         FCP
I0033      I0310         FCP
```

An I/O port number has four digits to indicate its location:

- The first digit locates the frame - R.
- The second digit indicates the I/O enclosure - E.
- The third digit is for the adapter - C.
- The fourth digit is for the Adapter port - P.

The second step in this process is to choose at least a pair from the list of available I/O ports and create a path. For availability reasons, use at least two links for path definitions.

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To define a path, use the following command:

```
dscli mkpprcpath -remotewwnn <WWN of your remote Storage Image> -consistgrp
-srclss <Source_LSS_ID> -tgtlss <Target_LSS_ID> -cfg <Source device configuration
file> <Source_IO_Port>:<Target_IO_PORT> <Source_IO_Port>:<Target_IO_PORT> ...
```

Note: The `consistgrp` option is intended for Metro Mirror.

Example 26-48 illustrates how to create a path from the source LSS 65 in the storage disk subsystem at site 1, to the target LSS 65 in the storage disk subsystem at site 2.

Example 26-48 mkpprcpath command example

```
dscli mkpprcpath -remotewwnn 5005076303FFC426 -consistgrp -srclss 65 -tgtlss 65 -cfg
$DSCLI/profile/DS-01.profile I0100:I0040 I0101:I0110
Date/Time: June 14, 2005 3:26:06 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00149I mkpprcpath: Remote Mirror and Copy path 65:65 successfully established.
```

To list the newly created paths, use the command **lspprc**, which is described in 26.11.1, “Query status of the paths” on page 395.

26.10.3 Create Global Copy volume pairs

To create Global Copy volume pairs, first list the volumes that may become Global Copy pairs. Once the volumes are identified, establish the Global Copy relationships for these pairs with the corresponding DS CLI commands.

Note: The following examples cover FB volumes. This is very similar for CKD volumes. The command sequence and structure are identical for both volume types. The focus here is rather on which DS CLI commands to use and on the sequence of these commands.

The first step is to see which Fixed Block volumes are available for Global Copy on the source and the target LSS. For this, we use the following commands:

```
dscli lsfbvol -lss <Source_LSS_ID> -cfg <Source device configuration file>
dscli lsfbvol -lss <Target_LSS_ID> -cfg <Target device configuration file>
```

Example 26-49 shows the commands and the corresponding output information: the volumes that are available on the source LSS 65 in the storage disk subsystem at site 1, and the potential target volumes in the storage disk subsystem at site 2.

Example 26-49 lsfbvol command example

```
dscli lsfbvol -lss 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 7:11:56 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
Name         ID   accstate datastate configstate deviceMTM datatype extpool cap (2^30B) cap (10^9B) cap (blocks)
=============================================================================================================
GM_SRC_GC01  6500 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
GM_SRC_GC02  6501 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152

dscli lsfbvol -lss 65 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 14, 2005 7:12:30 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
Name         ID   accstate datastate configstate deviceMTM datatype extpool cap (2^30B) cap (10^9B) cap (blocks)
=============================================================================================================
GM_TGT_GC01  6500 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
GM_TGT_GC02  6501 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
GM_TGT_JFC01 6502 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
GM_TGT_JFC02 6503 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
```


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Once you identify your Global Copy pairs, use the following DS CLI command to create the pairs:

```
dscli mkpprc -type gcp -tgtread -mode full -cfg <Source device configuration
file> <Source_Volume>:<Target_Volume> <Source_Volume>:<Target_Volume> ...
```

Note: The `type gcp` option is required to create Global Copy pairs. Use the option `mode full` to force a first full replication of the Global Copy pair.

Example 26-50 shows how to create two Global Copy pairs with source volumes `6500` and `6501` on the disk at site 1, and target volumes `6500` and `6501` on the disk subsystem at site 2.

Example 26-50 mkpprc to establish two Global Copy pairs

```
dscli mkpprc -type gcp -tgtread -mode full -cfg $DSCLI/profile/DS-01.profile 6500:6500 6501:6501
Date/Time: June 14, 2005 3:27:45 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 6500:6500 successfully created.
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 6501:6501 successfully created.
```

To list the Global Copy pairs use the command **lspprc** as described in 26.11.1, “Query status of the paths” on page 395.

26.10.4 Create FlashCopy relationships

The next step is to create FlashCopy pairs relationships between the B and C volumes.

If the FlashCopy pairs are in several LSSs, do not forget to select all of them during this step. If FlashCopy pairs are spread over several Storage images, run this process again on each of them.

You may first identify which volumes on the target storage image are available for FlashCopy. For this use the following command:

```
dscli lsfbvol -lss <LSS_ID> -cfg <Device configuration file>
```

Example 26-51 shows the command and its corresponding output: the list of potential volumes for FlashCopy relationships.

Example 26-51 lsfbvol to identify FlashCopy volume pairs

```
dscli lsfbvol -lss 65 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 14, 2005 7:12:30 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
Name         ID   accstate datastate configstate deviceMTM datatype extpool cap (2^30B) cap (10^9B) cap (blocks)
==========================================================================================================================
GM_TGT_GC01  6500 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
GM_TGT_GC02  6501 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
GM_TGT_JFC01 6502 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
GM_TGT_JFC02 6503 Online   Normal    Normal      2107-900  FB 512   P5             1.0           -      2097152
```

Now that you know the available volumes, use the following command to establish FlashCopy relationships using the selected ones:

```
dscli mkflash -record -persist -nocp -cfg <Device configuration file>
<Source_Volume>:<Target_Volume> <Source_Volume>:<Target_Volume> ...
```

Note: The `record` option in the command is required to keep a record of the changed tracks on both volumes. Using `record` implies the `persist` option, which keeps the relationship. This FlashCopy relationship for Global Mirror is also built upon the `nocp` option, which inhibits a background copy between source and target volumes.

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Example 26-52 shows the command that creates two FlashCopy relationships.

Example 26-52 mkflash to establish FlashCopy relationships for Global Mirror

```
dscli mkflash -record -nocp -cfg $DSCLI/profile/DS-02.profile 6500:6502 6501:6503
Date/Time: June 14, 2005 3:28:58 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
CMUC00137I mkflash: FlashCopy pair 6500:6502 successfully created.
CMUC00137I mkflash: FlashCopy pair 6501:6503 successfully created.
```

To list the new FlashCopy pairs, use the command **lsflash** as described in 26.11.3, “Query FlashCopy pairs” on page 396.

26.10.5 Create and start the Global Mirror session

For the creation of a Global Mirror session we have the DS CLI command **mksession**. This command defines a session number and populates the Global Mirror session with Global Copy source volumes.

Issue the following command to each LSS that has potential Global Mirror volumes:

```
dscli mksession -lss <LSS_ID> -cfg <Device configuration file> -volume <Volume>
<Volume> ... <Session_Number>
```

Example 26-53 illustrates how to create Global Mirror session number 01 for LSS 65 and add two Global Copy source volumes to this session.

Example 26-53 mksession to create a session and add two volumes

```
dsscli mksession -lss 65 -volume 6500-6501 -cfg $DSCLI/profile/DS-01.profile 01
Date/Time: June 14, 2005 3:29:46 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00145I mksession: Session 01 opened successfully.
```

Note that this command only adds volumes to the newly defined session number 01. It does not start the Consistency Groups formation process.

To list the session status, use the **lssession** command, which is described in 26.11.4, “Query volumes in the session” on page 396.

To start the Consistency Groups formation process, start the Global Mirror session. For this use the **mkmir** command. Also, when more than one storage disk subsystem participates with its primary volumes in a common Global Mirror session, you have to specify topology information in the command that starts the Global Mirror session.

The **mkmir** command has the following syntax:

```
dscli mkgmir -lss <Master LSS ID> -cginterval <Number of seconds> -coordinate
<Number of milliseconds> -drain <Number of seconds> -session <Session_ID> -cfg
<Master device configuration file>
<Master_Control_Path_LSS_ID>:<Subordinate_Control_Path_LSS_ID> ...
```

The following tuning parameters can be set at this time with the command:

- cginterval - Specifies how long to wait between the formation of Consistency Groups. If this number is not specified or is set to zero, then Consistency Groups are formed continuously.
- coordinate - Indicates the maximum time that Global Mirror processing queues host I/Os when Global Mirror starts to form a new Consistency Group. The default is 50 ms.

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- `drain` - Specifies the maximum Consistency Group drain time in seconds, and is the maximum amount of time that the consistent set of data is allowed to drain to the remote site before failing the current Consistency Group formation. The default is 30 seconds.

For a detailed discussion, see 22.4, “Consistency Groups” on page 260.

The command in Example 26-54 starts the session and the actual Consistency Group creation process. It uses the default session parameters.

Example 26-54 mkgmir

```
dscli mkgmir -lss 65 -session 01 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 3:30:33 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00162I mkgmir: Global Mirror for session 01 successfully started.
```

To list a Global Mirror session, use the command **showgmir** as described in 26.11.5, “Query Global Mirror session information” on page 397.

26.11 Control and Query Global Mirror with the DS CLI

This section lists the commands you use to control and query the Global Mirror environment.

26.11.1 Query status of the paths

To query the status of the paths use the DS CLI command **lspprcpath**:

```
dscli lspprcpath <Source_LSS_ID> -cfg <Source device configuration file>
```

Listing the path information for source LSS 65 in the storage disk subsystem at site 1, we have the result shown in Example 26-55.

Example 26-55 lspprcpath for LSS 65

```
dscli lspprcpath 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 3:26:29 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
Src Tgt State   SS   Port  Attached Port
========================================
65  65  Success FF65 I0100 I0040
65  65  Success FF65 I0101 I0110
```

26.11.2 Query Global Copy pairs

Use the **lspprc** command to display the list of Global Copy volume relationships with the corresponding status information. The syntax of the **lspprc** command is as follows:

```
dscli lspprc -cfg <Source device configuration file>
<Source_Volume>:<Target_Volume> <Source_Volume>:<Target_Volume> ...
```

or

```
dscli lspprc -l -cfg <Source device configuration file> <Source_Volume>
<Source_Volume> ...
dscli lspprc -l -cfg <target device configuration file> <Target_Volume>
<Target_Volume> ...
```


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If we query the volumes 6500 and 6501, that are in the storage disk subsystem at site 1, and have target volumes 6500 and 6501 in the storage disk subsystem at site 2, we will see the result shown in Example 26-56.

Example 26-56 lspprc command output

```
dscli lspprc -l -cfg $DSCLI/profile/DS-01.profile 6500-6501
Date/Time: June 14, 2005 3:28:08 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
ID        State        Reason Type        Out Of Sync Tracks Tgt Read Src Cascade Tgt Cascade Date Suspended SourceLSS Timeout (secs)
Critical Mode First Pass Status
=============================================================================================================================================
6500:6500 Copy Pending -     Global Copy 0               Enabled  Disabled   Disabled   Wed Dec 31 18:59:59 EST 1969 65       300
Disabled      True
6501:6501 Copy Pending -     Global Copy 0               Enabled  Disabled   Disabled   Wed Dec 31 18:59:59 EST 1969 65       300
Disabled      True

dscli lspprc -l 6500-6501 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 14, 2005 3:28:33 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
ID        State              Reason Type        Out Of Sync Tracks Tgt Read Src Cascade Tgt Cascade Date Suspended
SourceLSS Timeout (secs) Critical Mode First Pass Status
=============================================================================================================================================
6500:6500 Target Copy Pending -      Global Copy 0                 Enabled  Disabled   Disabled   Wed Dec 31 18:59:59 EST 1969 65
unknown        Disabled      Invalid
6501:6501 Target Copy Pending -      Global Copy 0                 Enabled  Disabled   Disabled   Wed Dec 31 18:59:59 EST 1969 65
unknown        Disabled      Invalid
```

26.11.3 Query FlashCopy pairs

Query the FlashCopy relationships with the DS CLI command **lsflash**. The syntax of the lsflash command is as follows:

```
dscli lsflash -cfg <Device configuration file> <Source_Volume>:<Target_Volume>
<Source_Volume>:<Target_Volume> ...
```

If we list FlashCopy information for source volumes 6500 and 6501, which have corresponding target volumes 6502 and 6503 on the storage disk subsystem at site 2, we see the results shown in Example 26-57.

Example 26-57 lsflash command output

```
dscli lsflash -l -cfg $DSCLI/profile/DS-02.profile 6500:6502 6501:6503
Date/Time: June 14, 2005 3:29:22 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWriteEnabled TargetWriteEnabled BackgroundCopy
OutOfSyncTracks DateCreated                  DateSynced
=============================================================================================================================================
6500:6502 65     0           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled Disabled       16384
Tue Jun 14 15:32:41 EDT 2005 Tue Jun 14 15:32:41 EDT 2005
6501:6503 65     0           300     Disabled   Enabled   Enabled    Disabled   Disabled           Disabled Disabled       16384
Tue Jun 14 15:32:41 EDT 2005 Tue Jun 14 15:32:41 EDT 2005
```

26.11.4 Query volumes in the session

The **lssession** command is used to display Global Mirror session information regarding the volumes in each session. Issue this command to query the status of all volumes that are associated with the sessions of a specified LSS.

The syntax of the **lssession** command is as follows:

```
dscli lssession <LSS_ID> -cfg <Device configuration file>
```

To list the volumes in LSS 65, see Example 26-58 on page 397. Note that the volumes are not participating in the Global Mirror session, they are in a *join pending* state. This may be because they have not yet completed their initial copy first pass.

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Example 26-58 lssession command (volumes not in session)

```
dscli lssession 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 3:30:10 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
LSS ID Session Status Volume VolumeStatus PrimaryStatus       SecondaryStatus   FirstPassComplete AllowCascading
==========================================================================================================================
65     01      Normal 6501   Join Pending Primary Copy Pending Secondary Simplex True              Disable
65     01      Normal 6500   Join Pending Primary Copy Pending Secondary Simplex True              Disable
```

Or we can get the result shown in Example 26-59. Note that the status of the volumes is now *active* and no longer *join pending*.

Example 26-59 lssession command (volumes in session)

```
dscli lssession 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 4:47:50 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
LSS ID Session Status         Volume VolumeStatus PrimaryStatus       SecondaryStatus   FirstPassComplete
AllowCascading
==========================================================================================================================
67     01      CG In Progress 6701   Active       Primary Copy Pending Secondary Simplex True              Disable
67     01      CG In Progress 6700   Active       Primary Copy Pending Secondary Simplex True              Disable
```

26.11.5 Query Global Mirror session information

The **showgmir** command displays detailed properties and performance metrics for the Global Mirror operations associated with a specified LSS. This command has the following syntax:

```
dscli showgmir -metrics <Master_LSS_ID> -cfg <Master device configuration file>
```

Note: The option `metrics` is used to display performance statistics.

If we ask for Global Mirror session information for the Master storage image, and there are no Subordinates, we see the result shown in Example 26-60.

Example 26-60 showgmir of running session with Master only

```
dscli showgmir 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 3:30:57 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
ID                          IBM.2107-7506551/65
Master Count                1
Master Session ID           0x01
Copy State                  Running
Fatal Reason                Not Fatal
CG Interval (seconds)       0
XDC Interval(milliseconds)  50
CG Drain Time (seconds)     30
Current Time                06/14/2005 15:34:17 EDT
CG Time                     06/14/2005 15:34:17 EDT
Successful CG Percentage    100
FlashCopy Sequence Number   0x42AF3139
Master ID                   IBM.2107-7506551
Subordinate Count           0
Master SSID                 -
Subordinate SSID            -
```

If there was the Master and one Subordinate in the running Global Mirror session, we would see the results shown in Example 26-61.

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Example 26-61 showgmir of running session with Master and Subordinate

```
dscli showgmir 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 14, 2005 5:00:35 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
ID                          IBM.2107-7506551/65
Master Count                1
Master Session ID           0x01
Copy State                  Running
Fatal Reason                Not Fatal
CG Interval (seconds)       0
XDC Interval(milliseconds) 50
CG Drain Time (seconds)     30
Current Time                06/14/2005 17:03:55 EDT
CG Time                     06/14/2005 17:03:55 EDT
Successful CG Percentage    93
FlashCopy Sequence Number   0x42AF463B
Master ID                   IBM.2107-7506551
Subordinate Count           1
Master SSID                 0xFF65
Subordinate SSID            0xFF67
```

If there was the Master only, and no Subordinate, and the Global Mirror session is paused, we would see the results shown in Example 26-62.

Example 26-62 showgmir of paused session with Master only)

```
dscli showgmir 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 10:23:07 AM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
ID                          IBM.2107-7506551/65
Master Count                1
Master Session ID           0x01
Copy State                  Paused
Fatal Reason                Not Fatal
CG Interval (seconds)       0
XDC Interval(milliseconds) 50
CG Drain Time (seconds)     30
Current Time                06/15/2005 10:26:25 EDT
CG Time                     06/15/2005 10:25:57 EDT
Successful CG Percentage    100
FlashCopy Sequence Number   0x42B03A75
Master ID                   IBM.2107-7506551
Subordinate Count           0
Master SSID                 -
Subordinate SSID            -
```

And if there was the Master and one Subordinate, in a paused Global Mirror session, we would have the result shown in Example 26-63.

Example 26-63 showgmir of a paused session with Master and Subordinate

```
dscli showgmir 65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 11:33:07 AM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
ID                          IBM.2107-7506551/65
Master Count                1
Master Session ID           0x01
Copy State                  Paused
Fatal Reason                Not Fatal
CG Interval (seconds)       0
XDC Interval(milliseconds) 50
CG Drain Time (seconds)     30
```


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```
Current Time               06/15/2005 11:37:46 EDT
CG Time                    06/15/2005 11:36:01 EDT
Successful CG Percentage   100
Successful CG Percentage   94
FlashCopy Sequence Number  0x42AF463B
Master ID                  IBM.2107-7506551
Subordinate Count          1
Master SSID                0xFF65
Subordinate SSID           0xFF67
```

26.11.6 Pause Global Mirror session

Use the **pausegmir** command to pause Global Mirror processing. This allows you to temporarily suspend Global Mirror processing attempts to form consistency groups, for the specified session. The syntax of the **pausegmir** command is as follows:

```
dscli pausegmir -lss <Master LSS ID> -session <session_ID> -cfg <Master device
configuration file>
<Master_Control_Path_LSS_ID>:<Subordinate_Control_Path_LSS_ID> ...
```

One reason you would pause a Global Mirror session is to make modifications to the Global Mirror tuning parameters, because these parameters can be modified when you resume the session. See 26.11.7, “Resume Global Mirror session” on page 399.

Example 26-64 shows the result of pausing the Global Mirror session 01. This session consisted only of a Master (no Subordinates), which was running in LSS 65 on the storage image at site 1.

Example 26-64 pausegmir with Master only

```
dscli pausegmir -lss 65 -session 01 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 10:22:39 AM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00163I pausegmir: Global Mirror for session 01 successfully paused.
```

Example 26-65 shows the result of pausing Global Mirror session 01. This time, the session consisted of a Master running in LSS 65 of one storage image, and a Subordinate running in LSS 67 of a different storage image.

Example 26-65 pausegmir with Master and Subordinate

```
dscli pausegmir -lss 65 -session 01 -cfg $DSCLI/profile/DS-01.profile
IBM.2107-7506551/65:IBM.2107-7505801/67
Date/Time: June 15, 2005 11:32:46 AM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00163I pausegmir: Global Mirror for session 01 successfully paused.
```

To visualize the paused Global Mirror session, use the command **showgmir** as discussed in 26.11.5, “Query Global Mirror session information” on page 397, and illustrated in Example 26-62 and Example 26-63 on page 398.

26.11.7 Resume Global Mirror session

The **resumegmir** command resumes Global Mirror processing for a specified session. If you have issued a **pausegmir** command to pause Global Mirror processing, issue the **resumegmir** command to continue Global Mirror processing. The syntax of the **resumegmir** command is as follows:

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```
dscli resumegmir -lss <Master LSS ID> -cginterval <Number of seconds>
-coordinate <Number of milliseconds> -drain <Number of seconds> -session
<session_ID> -cfg <Master device configuration file>
<Master_Control_Path_LSS_ID>:<Subordinate_Control_Path_LSS_ID> ...
```

One reason you would pause and resume a session is to be able to modify the Global Mirror session tuning parameters. You can specify new values for these parameters:

- `cginterval` - Specifies how long to wait between the formation of Consistency Groups. If this number is not specified or is set to zero, Consistency Groups are formed continuously.
- `coordinate` - Indicates the maximum time that Global Mirror can hold the primary host I/O processing, while coordinating to start forming a Consistency Group.
- `drain` - Specifies the maximum Consistency Group drain time in seconds. It is the maximum amount of time that the consistent set of data is allowed to drain to the remote site before failing the current Consistency Group formation. The default is 30 seconds.

Note: For a deeper understanding of these options and how to use them, see 22.4.2, “Consistency Group parameters” on page 262.

Example 26-66 shows the results of resuming Global Mirror session 01. This session consisted only of a Master (no Subordinates), which was running in LSS `65` on the storage image at site 1.

Example 26-66 resumegmir with Master only

```
dscli resumegmir -lss 65 -session 01 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 10:56:51 AM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00164I resumegmir: Global Mirror for session 01 successfully resumed.
```

To visualize the resumed Global Mirror session use the command **`showgmir`** as discussed in 26.11.5, “Query Global Mirror session information” on page 397, and illustrated in Example 26-60 on page 397 and Example 26-61 on page 398.

26.11.8 Change a Global Mirror session

Issue the **`chsession`** command to add or remove volumes to/from a Global Mirror session. The syntax of the **`chsession`** command is as follows:

```
dscli chsession -lss <LSS ID> -action <add or remove> -volume <volume_ID>
<Session_ID> -cfg <Device configuration file>
```

Example 26-67 shows the result of removing volume `6500` from the session `01` on LSS `65`.

Example 26-67 chsession

```
dscli chsession -lss 65 -action remove -volume 6500 01 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 2:19:19 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00147I chsession: Session 01 successfully modified.
```

To query Global Mirror session information use the command **`lssession`** as described in 26.11.4, “Query volumes in the session” on page 396.

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26.12 Site switch basic operations using the DS CLI

In this section we show examples of how to do the steps to effect a site switch, using DS CLI commands. For a detailed discussion regarding site swap considerations see 26.4, “Primary site failure and recovery management with TSO” on page 352.

26.12.1 Perform a Global Copy failover

When switching sites, use the **failoverpprc** command to change a secondary device into a primary suspended device, while leaving the primary device in its current state. This command succeeds even if the paths are down and the volume at the other site is unavailable or nonexistent. The syntax of the **failoverpprc** command is as follows:

```
dscli failoverpprc -type gcp -cfg <Target device configuration file>
<Source_Volume>:<Target_Volume> <Source_Volume>:<Target_Volume> ...
```

A failover operation from site 1 to site 2 means that site 2 will be active in a *suspended* state, but the replication process will not be active anymore, in either direction. If there was no outage on the primary site, the primary and the recovery volumes will still be available and accessible at the end of a failover operation on the recovery site. If there was an outage on the primary site, only the recovery volumes will still be available and accessible at the end of a failover operation on the recovery site.

Example 26-68 shows a failover operation on two Global Copy secondary volumes, at site 2.

Example 26-68 failover operation at site 2

```
dscli failoverpprc -type gcp 6500:6500 6501:6501 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 15, 2005 14:56:32 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
CMUC00196I failoverpprc: Remote Mirror and Copy pair 6500:6500 successfully reversed.
CMUC00196I failoverpprc: Remote Mirror and Copy pair 6501:6501 successfully reversed.
```

To query Global Copy information use the command **lspprc** as described in 26.11.2, “Query Global Copy pairs” on page 395.

26.12.2 Perform a Global Copy failback

The **failbackpprc** command copies the required data from the source volume to the target volume in order to resume mirroring. The syntax of the **failbackpprc** command is as follows:

```
dscli failback -type gcp -cfg <Target device configuration file>
<Source_Volume>:<Target_Volume> <Source_Volume>:<Target_Volume> ...
```

A failback on site 2 means that site 2 will be active as the source of a Global Copy replication process from site 2 to site 1. The failback operation resynchronizes the volume pairs, and is used in combination with the failover operation as part of the site switch procedure.

Example 26-69 on page 402 shows a failback operation of two Global Copy pairs.

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Example 26-69 failback - erasing data on site 1 with data from site 2

```
dscli failbackpprc -type gcp -tgtread 6500:6500 6501:6501 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 15, 2005 12:32:27 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
CMUC00197I failbackpprc: Remote Mirror and Copy pair 6500:6500 successfully failed back.
CMUC00197I failbackpprc: Remote Mirror and Copy pair 6501:6501 successfully failed back.
```

To query Global Copy information use the command **lspprc** as described in 26.11.2, “Query Global Copy pairs” on page 395.

26.12.3 Create a FlashCopy for backup

To create new FlashCopy relationships for one or several pairs of volumes, using DS CLI commands, it is necessary to perform a two-step procedure.

If FlashCopy pairs are in several LSSs, do not forget to select all of them during the process. If FlashCopy pairs are spread over several storage images, run this process on each of them.

The first step is to find out which volumes are available on the Global Mirror target storage image for establishing FlashCopy pairs. For a fixed block (FB) volume use the command:

```
dscli lsfbvol -lss <LSS_ID> -cfg <Device configuration file>
```

For CKD volumes use the command:

```
dscli lsckdvol -lss <LSS_ID> -cfg <Device configuration file>
```

Example 26-70 shows the **lsfbvol** command result.

Example 26-70 lsfbvol

```
dscli lsfbvol -lss 65 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 14, 2005 7:15:47 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
Name         ID   accstate datastate configstate deviceMTM datatype extpool cap (2^30B) cap (10^9B) cap (blocks)
==========================================================================================================================
GM_TGT_GC01  6500 Online   Normal    Normal      2107-900  FB 512   P5             1.0          -      2097152
GM_TGT_GC02  6501 Online   Normal    Normal      2107-900  FB 512   P5             1.0          -      2097152
GM_TGT_JFC01 6502 Online   Normal    Normal      2107-900  FB 512   P5             1.0          -      2097152
GM_TGT_JFC02 6503 Online   Normal    Normal      2107-900  FB 512   P5             1.0          -      2097152
GM_TGT_FCA01 6504 Online   Normal    Normal      2107-900  FB 512   P5             1.0          -      2097152
GM_TGT_FCA02 6505 Online   Normal    Normal      2107-900  FB 512   P5             1.0          -      2097152
```

The second step is to create FlashCopy pairs. For this use the command **mkflash**:

```
dscli mkflash -wait -tgtinhibit -cfg <Device configuration file>
<Source_Volume>:<Target_Volume> <Source_Volume>:<Target_Volume> ...
```

Note: The `wait` option is not required, but can help to know when the process is finished. The `tgtinhibit` option is also not required, but can prevent any misuse of the target volumes during the FlashCopy process.

Example 26-71 shows how to create two FlashCopy pairs on the storage unit on site 2, using volumes 6500 and 6501 as source volumes, and volumes 6504 and 6504 as target volumes.

Example 26-71 mkflash to create two FlashCopy pairs

```
dscli mkflash -record -nocp -cfg $DSCLI/profile/DS-02.profile 6500:6504 6501:6505
Date/Time: June 14, 2005 3:35:09 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
CMUC00137I mkflash: FlashCopy pair 6500:6504 successfully created.
CMUC00137I mkflash: FlashCopy pair 6501:6505 successfully created.
```


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To query the newly created FlashCopy relationships use the command **lsflash** as described in 26.11.3, “Query FlashCopy pairs” on page 396.

26.12.4 Verify FlashCopy status between B and C volumes

After a local site failure, you will need to check the status of all FlashCopy pairs that were in the Global Mirror session.

Let us see how to verify and eventually take some corrective actions on the Global Mirror FlashCopy pairs at the remote site, when there has been a primary site failure. For a more detailed discussion on this topic, see 26.4.4, “Check Global Mirror FlashCopy status between B and C volumes” on page 355 and 23.7.4, “Check for valid Consistency Group state” on page 285.

To verify the *sequence number* and *revertible* state of the FlashCopy sessions, first use the command **lsflash** as described in 26.11.3, “Query FlashCopy pairs” on page 396.

Note: At this level, we do not use the command **setflashrevertible** because Global Mirror has already issued this command internally.

Secondly, execute either the **commitflash** or the **revertflash** command, depending on whether or not the FlashCopy pairs were successfully set to a revertible state, and whether their sequence numbers are equal or not.

We need to remember that Global Mirror is a distributed solution:

- When a Consistency Group is processed, the Master acts as a session manager and does an incremental revertible FlashCopy on its own recovery site, while at the same time asking its Subordinates to also perform such a task at their recovery sites.
- When a Consistency Group is in progress, several incremental revertible FlashCopy operations may be running. The FlashCopy process is looking at the change recording bit map on the B volumes, and is comparing it with the target bit map on the C volumes. When the incremental FlashCopy is finished, the change recording bit map is cleared and, therefore, all the changes are committed on the C volumes. The corresponding FlashCopy pairs are set to a nonrevertible state by the Master.

These are the reasons why one of these four situations could occur:

1. If all FlashCopy pairs are nonrevertible and their sequence numbers are equal, it means that the Consistency Group process had finished.

   There is no action required because the Consistency Group is intact on the C volumes.

2. If some FlashCopy pairs are revertible and their sequence numbers are equal, and others are not revertible and their sequence numbers are equal but do not match the revertible FlashCopies sequence number, it means that some FlashCopy pairs are running in a Consistency Group process and some have not yet started their incremental process.

   To preserve the consistency we need to overwrite new data with data saved at the last consistency formation for the FlashCopy pairs already in the new Consistency Group process. For this use the **revertflash** command of the DS CLI.

3. If all FlashCopy pairs are revertible and their sequence numbers are equal, it means that all the FlashCopy pairs are running in a Consistency Group process and none have finished their incremental process.

   We need to overwrite new data with data saved at the last consistency formation for all the FlashCopy pairs. For this use the **revertflash** command of the DS CLI.

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4. If some FlashCopy pairs are revertible and at least one is not revertible, but all their sequence numbers are equal, it means that some FlashCopy pairs are running in a Consistency Group process and some have already finished their incremental process.

   We need to commit data to a target volume to form a consistency between the source and target. Only the FlashCopy pairs that have not already finished their incremental process will have to commit the changes because nonrevertible pairs have already committed theirs. For this use the **commitflash** command of the DS CLI. If you use this command on FlashCopy pairs that are not revertible, it will only display error messages.

The syntax of the **revertflash** and the **commitflash** commands is as follows:

```
dscli revertflash -seqnum <FlashCopy_Sequence_NB> -cfg <Device configuration
file> <Source_Volume> <Source_Volume> ...
dscli commitflash -seqnum <FlashCopy_Sequence_NB> -cfg <Device configuration
file> <Source_Volume> <Source_Volume> ...
```

Example 26-72 shows the **revertflash** command on the FlashCopy pairs with the source volumes 6500 and 6501, which are on the storage disk subsystem that is at site 2, and the **lsflash** command that displays the sequence number 9D9B as the actual sequence number for both pairs,

Example 26-72 revertflash command

```
dscli revertflash -seqnum 9D9B 6500 6501 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 15, 2005 5:31:34 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
CMUC00171I revertflash: FlashCopy volume pair 6500:6500 successfully reverted.
CMUC00171I revertflash: FlashCopy volume pair 6501:6501 successfully reverted.
```

To reverse the FlashCopy relationship, and copy the data from the target volume to the source volume, do a Fast Reverse Restore (FRR) process. To do this, use the following command:

```
dscli reverseflash -fast -tgtpprc -seqnum <FlashCopy_Sequence_NB> -cfg <Device
configuration file> <Source_Volume> <Source_Volume> ...
```

Example 26-73 shows the **reverseflash** command on the FlashCopy pairs with source volumes 6500 and 6501, which are on the storage disk subsystem that is at site 2.

Example 26-73 reverseflash

```
dscli reverseflash -fast -tgtpprc 6500:6502 6501:6503 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 15, 2005 6:23:50 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
CMUC00169I reverseflash: FlashCopy pair 6500:6502 successfully reverse.
CMUC00169I reverseflash: FlashCopy pair 6501:6503 successfully reverse.
```

To query the FlashCopy session status, use the command **lsflash** as described in 26.11.3, “Query FlashCopy pairs” on page 396.

26.13 Remove the Global Mirror environment with the DS CLI

In this section we provide the details on how to remove a Global Mirror environment with the DS Command-Line Interface.

The components to be removed, as well as the procedure to clean up the environment, are similar to other interfaces. See also discussions in 26.5, “Remove Global Mirror environment using TSO” on page 360 and 26.7, “Remove a Global Mirror environment using ICKDSF” on page 368.

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The Global Mirror environment cleanup process can be structured in five consecutive steps:

1. End Global Mirror processing.
2. Remove the Global Mirror volumes and the session from the involved LSSs.
3. Remove FlashCopy pairs.
4. Remove Global Copy pairs.
5. Remove paths:
   a. Between source and target Global Copy LSSs.
   b. Within site 1, between the Master and the Subordinate LSSs. This task is not required if you have only one source storage image.

26.13.1 End Global Mirror processing

Before you end Global Mirror processing, first display the session information using the **showgmir** command as described in 26.11.5, “Query Global Mirror session information” on page 397.

To end Global Mirror processing for the specified session, use the **rmgmir** command. The syntax of the **rmgmir** command is as follows:

```
dscli rmgmir -quiet -lss <Master LSS ID> -cfg <Master device configuration
file> <Master_Control_Path_LSS_ID>:<Subordinate_Control_Path_LSS_ID> ...
```

Example 26-74 illustrates how to end Global Mirror session 01 processing. Although this command might interrupt the formation of a consistency group, every attempt is made to preserve the previous consistent copy of the data on the FlashCopy target volumes. If, due to failures, this command cannot complete without compromising the consistent copy, the command stops processing and an error code is issued. If this occurs, reissue the **rmgmir** command with the **-force** parameter to force the command to stop the Global Mirror process.

Example 26-74 rmgmir on Master LSS

```
dscli rmgmir -quiet -lss 65 -session 01 -cfg $DSCLI/profile/DS-01.profile 01
Date/Time: June 15, 2005 2:18:17 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00165I rmgmir: Global Mirror for session 01 successfully stopped.
```

Note: The `quiet` option turns off the confirmation prompt for this command.

26.13.2 Remove Global Mirror volumes and the session from each LSS

Before you remove the Global Mirror session from each LSS, first display the LSS session information with the **lssession** command as described in 26.11.4, “Query volumes in the session” on page 396.

Now, first remove the associated volumes from the session. For this, use the command **chsession** as described in 26.11.8, “Change a Global Mirror session” on page 400.

Next, remove the session with the **rmsession** command. The syntax of the **rmsession** command is as follows:

```
dscli rmsession -quiet -lss <LSS_ID> -cfg <Device configuration file>
<Session_Number>
```

Example 26-75 on page 406 shows how to remove session number `01` for the LSS `65` that is the Master.

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Example 26-75 rmsession

```
dscli rmsession -quiet -lss 65 01 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 2:20:05 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00146I rmsession: Session 01 closed successfully.
```

Note: The `quiet` option turns off the confirmation prompt for this command.

26.13.3 Remove FlashCopy pairs

To remove the FlashCopy pairs you use the command **rmflash**. The syntax of the **rmflash** command is as follows:

```
dscli rmflash -quiet -seqnum <FlashCopy_Sequence_NB> -cfg <Device configuration
file> <Source_Volume>:<Target_Volume> <Source_Volume>:<Target_Volume> ...
```

If FlashCopy pairs are in several LSSs, select all of them during this process. If FlashCopy pairs are spread over several storage images, run this process again on each of them.

Example 26-76 rmflash

```
dscli rmflash -quiet -seqnum 0000 6500:6502 6501:6503 -cfg $DSCLI/profile/DS-02.profile
Date/Time: June 15, 2005 2:21:21 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7573731
CMUC00140I rmflash: FlashCopy pair 6500:6502 successfully removed.
CMUC00140I rmflash: FlashCopy pair 6501:6503 successfully removed.
```

In Example 26-76 we remove two FlashCopy pairs that were established between the source volumes `6500` and `6501` and the corresponding target volumes `6502` and `6503`.

Note: The `quiet` option turns off the confirmation prompt for this command.

26.13.4 Remove Global Copy pairs

To remove the Global Copy pairs we use the command **rmpprc**. The syntax of the **rmpprc** command is as follows:

```
dscli rmpprc -dev storage_image_ID -remotedev SourceVolumeID:TargetVolumeID
```

If the Global Copy pairs are in several LSSs, select all of them during this process. If Global Copy pairs are spread over several storage images, run this process again on each of them.

Example 26-77 rmpprc

```
dscli rmpprc -quiet 6500:6500 6501:6501 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 2:23:19 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 6500:6500 relationship successfully withdrawn.
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 6501:6501 relationship successfully withdrawn.
```

In Example 26-77 we remove two Global Copy pairs that were established between source volumes `6500` and `6501` in the storage disk subsystem at the local site, and the same volume numbers in the storage disk subsystem at the remote site.

26.13.5 Remove paths

Finally we remove the paths with the command **rmpprcpath**. The syntax of the **rmpprcpath** command is as follows:

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```
dscli>rmpprcpath -dev storage_image_ID -remotedev storage_image_ID -remotewwnn
wwnn source_LSS_ID:target_LSS_ID ...
```

You need to repeat this process for each data path between the Global Copy source and target storage images, as well as for the paths that connect the Global Mirror Master with its Subordinates if there was more than one source storage image involved.

Example 26-78 rmpprcpath

```
dscli rmpprcpath -quiet 65:65 -cfg $DSCLI/profile/DS-01.profile
Date/Time: June 15, 2005 2:24:05 PM EDT IBM DSCLI Version: 5.0.3.134 DS: IBM.2107-7506551
CMUC00150I rmpprcpath: Remote Mirror and Copy path 65:65 successfully removed.
```

In Example 26-78 we remove a path from the source LSS 65 in the storage disk subsystem at site 1 to the target LSS 65 in the storage disk subsystem at site 2.

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Part 7

Interoperability

In this part we discuss the interoperability of the DS6000 Copy Services functions with other IBM storage disk subsystems.

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27

Combining Copy Service functions

In this chapter we discuss the interoperability of Global Copy, Metro Mirror, and FlashCopy. Examples and suggestions are also given for this interoperability.

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27.1 Data migration

Combining the Copy Service functions Metro Mirror and Global Mirror into an environment with double cascading makes it possible to maintain data consistency while migrating data.

There are two possibilities for accomplishing data consistency during a migration using an environment that has double cascading. The first possibility is to shut down all applications at the local site and let the out-of-sync drain completely. The second possibility is to change the Global Copy relationships to Metro Mirror, then when the out-of-sync is approaching zero. a freeze is issued to the changed relationships.

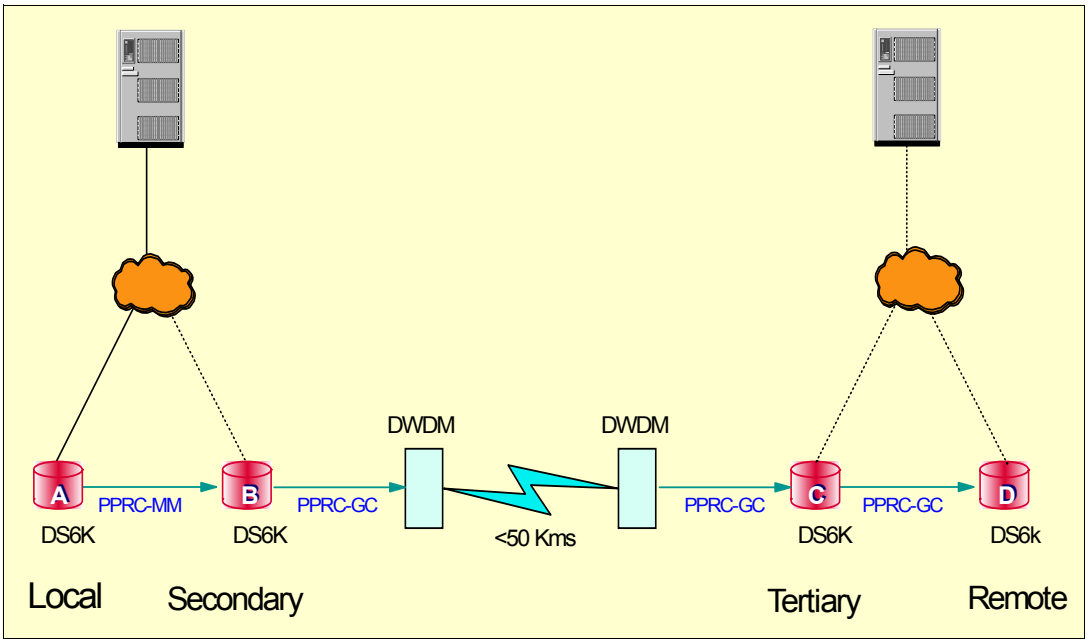

Figure 27-1 Double cascading example

Figure 27-1 shows double cascading with a Metro Mirror relationship from the local to the secondary, and Global Copy from the secondary to the tertiary site, and from the tertiary to the remote site. There is a cascading relationship at both the secondary and tertiary site where the volumes are both secondaries and primaries. In this example, if all applications are stopped at the local site, then the local, secondary, tertiary, and remote will reach a point after some time where they are all equal; therefore, they will be consistent and data has successfully been migrated to the remote site volumes.

In the second approach to provide data consistency during migration, again looking at the example in Figure 27-1, a freeze is first issued to the Metro Mirror relationship from the local to secondary site. Since Metro Mirror is running between the local to secondary site, there is already a synchronous relationship. Therefore, the secondary volumes are consistent with the local site volumes at this time.

The next step would be to change all the Global Copy relationships to Metro Mirror relations and then issue a freeze when the out-of-sync has reached zero. When the out-of-sync is fully drained, then there is a consistent relationship from the secondary to the remote and migration to the remote is complete. Data migration has sent a snapshot of data to the remote site so that there is consistency. This process would be used when production cannot be stopped, since production keeps running at the local site. However, once the freeze is first issued on the Metro Mirror relationship, from that point forward the remote will only be

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consistent with the secondary. The local during this process is still being updated and is changing. The remote will have a snapshot of the time since the freeze was issued.

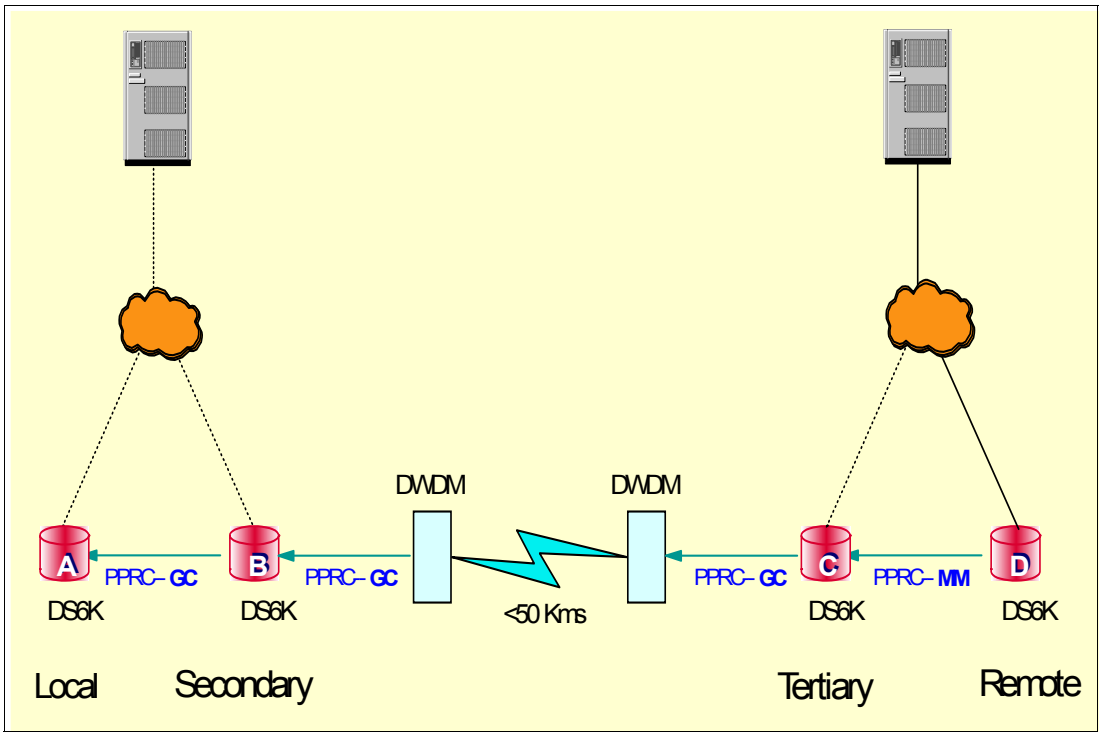

Figure 27-2 Global Copy changed to Metro Mirror and direction reversed

Once data migration and consistency have been accomplished at the remote site, you can start production at the remote site, if desired. In this case all applications must first be stopped at the local site and the direction of the mirror is reversed so that Metro Mirror is now running from the remote to the tertiary site, and Global Copy is running from the tertiary site to the secondary site and then to the primary site. Figure 27-2 shows the new configuration with the Metro Mirror and Global Copy reversed and production running at the remote site.

In this example, it is shown that to protect the production at the remote, the remote copy relations can be reversed to use the tertiary, secondary, or local volumes as targets. These copy relations would be created before starting production at the remote site. Since the relationships from the secondary to the tertiary and from the tertiary to the remote are both in a cascaded relationship, to reverse the directions Global Copy must first be removed and then recreated in the reverse directions.

Note: No I/O should be running at any time at any of the sites while the reversal of the remote copy relations is being done. This would corrupt the resulting data, and consequently require a full copy.

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Interoperability between DS6000 and DS8000

In this chapter we show the interoperability between the Copy Services functions in the DS6000 and the DS8000. It contains the following sections:

- DS6000 and DS8000 Copy Services interoperability
- Preparing the environment
- RMC: Establishing paths between DS6000 and DS8000
- Managing Metro Mirror or Global Copy pairs
- Managing DS6000 to DS8000 Global Mirror
- Managing DS6000 and DS8000 FlashCopy

Note: Remote Mirror and Copy (RMC) was formerly called Peer-to-Peer Remote Copy (PPRC). All references to PPRC are interchangeable with RMC.

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28.1 DS6000 and DS8000 Copy Services interoperability

Copy Services operations are supported between the DS6000 and the DS8000. This means you can have a mixed Copy Services environment that contains both devices.

28.2 Preparing the environment

Before starting Copy Services operations in a mixed DS6000 and DS8000 environment, you must ensure that this environment is set up correctly.

28.2.1 Minimum microcode levels

To manage Copy Services in a mixed environment, you need to have licensed internal code bundle 6.0.600.9 or later on your DS6000. You also need your IBM Service Representative to install code bundle 6.0.500.52 or later on your DS8000.

28.2.2 Hardware and licensing requirements

To establish Remote Mirror and Copy pairs (also known as PPRC pairs) between a DS6000 and a DS8000, the DS6000 and the DS8000 must both have the appropriate Remote Mirror and Copy (RMC) licenses.

The DS6000 and DS8000 must also have Fibre Channel adapters that have connectivity to each other, either directly or via Fibre Channel switches. ESCON adapters cannot be used to mirror a DS6000 with a DS8000.

z/OS Global Mirror RMZ (formerly XRC)

The DS6000 cannot be used as a z/OS Global Mirror primary Storage Unit. There is consequently no feature code for z/OS Global Mirror (RMZ) for DS6000. The DS6000 can be used as a secondary Storage Unit.

28.2.3 Network connectivity

Network connectivity requirements depend on how you want to manage the environment. If you plan to use System z interfaces like TSO or ICKDSF, there are no network connectivity requirements. The commands are sent inband through FICON or ESCON. If, however, you plan to use the DS CLI or the DS GUI, your requirements are as follows:

- For FlashCopy management:
  - If you want to use the DS8000 DS GUI to manage FlashCopy on the DS6000, then you need network connectivity between the DS8000 HMCs and the DS6000 SMCs.
  - If you want to use the DS6000 DS GUI to manage FlashCopy on the DS8000, then you need network connectivity between the DS8000 HMCs and the DS6000 SMCs.
  - If you want to use the DS CLI to manage FlashCopy on either the DS6000 or the DS8000 then the DS8000 HMCs and the DS6000 SMCs do not need to be connected by a network. However, the server on which the DS CLI is installed must have network connectivity to both the SMC and the HMC.
  - If you have PPRC links between the DS6000 and DS8000, you can also use remote FlashCopy to establish FlashCopies of the Remote Mirror target volumes.
- For creating Remote Mirror and Copy (RMC), also known as Peer-to-Peer Remote Copy (PPRC) paths and pairs:

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– In a mixed environment, one system is the source (local) and one is the target. If you want to be able to manage the PPRC paths and pairs from either machine, then you need network connectivity between the DS6000 SMC and the DS8000 HMC. If you use DS CLI, the SMC and HMC do have to be able to communicate with each other, but the DS CLI machine must be able to communicate with both the HMC and the SMC.

– If you do not plan to use the remote system as a source and you do not intend to use the DS Storage Manager GUI to manage the pairs and paths, then network connectivity to the remote machine (assuming the remote machine is at a remote site) is not necessary. This is because, when you use the DS CLI, all path and pair establishment is done by connecting to the source machine (the local machine). In a disaster recovery scenario, you will have travel to the remote site to perform management tasks for the remote machine. This setup is not recommended because it is less flexible.

28.2.4 Creating matching user IDs and passwords

When you want to use the DS CLI or DS GUI to perform Copy Services operations, you must authenticate with a valid user ID and password. When you use the DS6000 DS GUI to perform an operation that requires it to issue a command to a DS8000, it must authenticate with the DS8000. The DS user ID and password that you used to log on to the DS6000 DS GUI is used to authenticate with the DS8000 HMC. The same applies if you use the DS8000 DS GUI to manage a DS6000. This means that the same user ID and password must be defined in both the SMC and the HMC. This task must be manually performed. If, instead of the DS GUI, you only use the DS CLI, then this requirement does not exist. However, it is still of benefit to use a matching user ID and password to manage machines in either Storage Complex.

Note: A DS8000 Storage Complex is made of up of either one or two HMCs that together manage one or two DS8000 Storage Units. A DS6000 Storage Complex consists of either one or two SMCs that together manage one or two DS6000 Storage Units.

28.2.5 Updating the DS CLI profile

If you plan to use the DS CLI to manage your mixed environment, you can create a profile to simplify your connection to the DS CLI, commands, and script operations. To achieve this, add extra lines as shown in Example 28-1. In this example, the DS6000 is considered the local system, while the DS8000 is considered the remote system.

Example 28-1 Possible modification to a DS CLI profile

```
# DS6000
# hmc1 is the DS6000 SMC
hmc1: 10.0.0.100
# devid is the serial number of the DS6000
devid: IBM.1750-1300247
# remotedevid is the serial number of the DS8000
remotedevid: IBM.2107-7503461
# Username is a user created on the ESS Specialist that matches the userid on the DS6000
 username:admin
# The password for the admin user id. Placing it here is not very secure.
password:passw0rd
# The password file is created using the managepwfile and is a better way to manage this.
# pwfile:security.dat
```


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Putting the password in the profile is not very secure (because it is stored in a plain text file), but it might prove more convenient. A password file can be created using **managepwfile** and is a better way to manage this. After creating the password file (which by default is called *security.dat*), you can remove the password from the profile and instead specify the pwfile file.

The command to create a passwd file in this example is:

```
managepwfile -action add -name admin -pw passw0rd
```

A simple method when you have multiple servers to manage is to create multiple profile files. Then, when you start DS CLI, you can specify the profile file that you wish to use with the `-cfg` parameter. In a Windows environment, you could have multiple Windows batch files (BAT files), one for each machine you wish to manage. The profile shown in Example 28-1 on page 417 could be saved in the C:\program files\ibm\dscli\profile directory as 1750source.profile. Then you could create a simple Windows BAT file with three lines as shown in Example 28-2.

Example 28-2 Windows BAT file to start a specific profile

```
title DS CLI Local DS6800 1300247 Remote IBM.2107-7503461
cd C:\Program Files\ibm\dscli\profile
dscli -cfg 1750source.profile
```

We saved the BAT file onto the Windows desktop and started it by double-clicking the icon. The DS CLI opened and started the specified profile. By creating a BAT file and profile for each machine, you can simplify the process of starting the DS CLI. You can also specify the profile when starting DS CLI from inside a script, or when running the DS CLI in script mode.

28.2.6 Adding the Storage Complex

If you wish to use a single DS GUI to manage both FlashCopy and Remote Mirror and Copy pairs on your DS6000 and DS8000, you have to add the Storage Complex of one Storage Unit (such as a DS6000), to the Storage Complex of the other Storage Unit (such as a DS8000). Note that you have to do this operation once in each direction. In other words, you have to add the DS6000 to the DS8000 and then add the DS8000 to the DS6000.

Adding the DS6000 Storage Complex to a DS8000 Storage Complex

You add a DS6000 Storage Complex to a DS8000 Storage Complex as follows.

1. Connect to the DS8000 HMC with the DS GUI.
2. Click **Real-time manager**.
3. Click **Manage hardware**.
4. Click **Storage complexes**.
5. Select **Add**.

6.

Important: Make sure that the user ID that you use to log on to the DS8000 DS GUI also exists on the DS6000 SMC and that it has the same password. If not, the operation to add the Storage Complex will fail. You must always use this user ID for multi-complex management.

Figure 28-1 shows the Add Storage Complex panel that opens.

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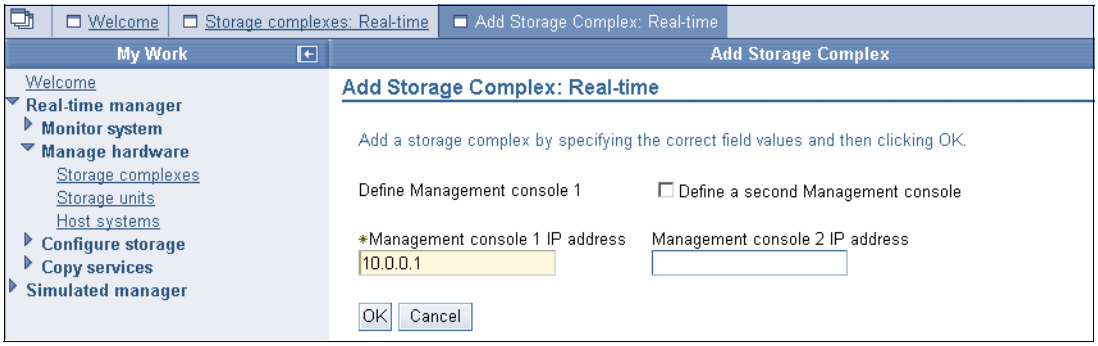

Figure 28-1 Add DS6000 complex to DS8000

7. Enter the IP address of the DS6000 SMC into the Management console 1 IP field. If you have a second SMC, select **Define a second Management console** and enter the second SMC address into the Management console 2 IP field. Click **OK**.
8. When the add Storage Complex operation is complete, the Storage Complex panel shows the DS6000 SMC as an additional Storage Complex.
9. Having added the DS6000 Storage Complex to the DS8000 Storage Complex, you are now able to use the DS8000 DS GUI to create paths and Remote Mirror and Copy pairs, where the DS6000 is the source device. You can also use the DS8000 DS GUI to manage FlashCopy pairs on the DS6000.

Note: The steps to add the DS6000 Storage Complex to the DS8000 Storage Complex cannot be performed with the DS CLI. This is by design. However, if you don't plan to use the GUI, this will not be an issue.

Adding the DS8000 Storage Complex to a DS6000 Storage Complex

You add a DS8000 Storage Complex to a DS6000 Storage Complex as follows:

1. Connect to the DS6000 SMC using the DS GUI.
2. Click **Real-time manager**.
3. Click **Manage hardware**.
4. Click **Storage complexes**.
5. Select **Add Storage Complex**.

Important: Make sure that the user ID you use to log on to the DS6000 DS GUI also exists on the DS8000 HMC and that it has the same password. If not, the operation to add the Storage Complex will fail. You will need to always use this same user ID for multi-complex management.

Figure 28-2 shows the Add Storage Complex panel that opens.

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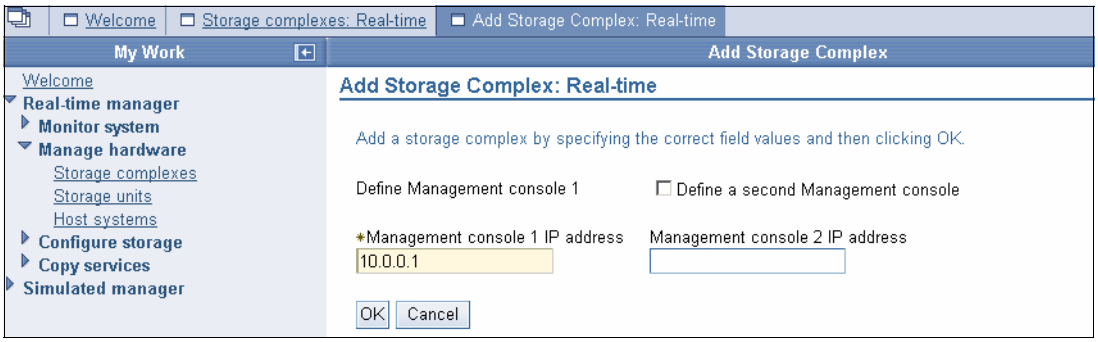

Figure 28-2 Add DS8000 complex to DS6000

6. Enter the IP address of the DS8000 HMC in the Management console 1 IPfield. If you have a second DS8000 HMC, select **Define a second Management console** and enter the second HMC address in the Management console 2 IP field. Click **OK**.
7. When the add Storage Complex operation completes, the Storage Complex panel shows the DS8000 HMC as an additional Storage Complex. In Figure 28-3, a DS6000 SMC, an ESS 800 Copy Services Server, and a DS8000 HMC are all defined in one DS6000 DS GUI.

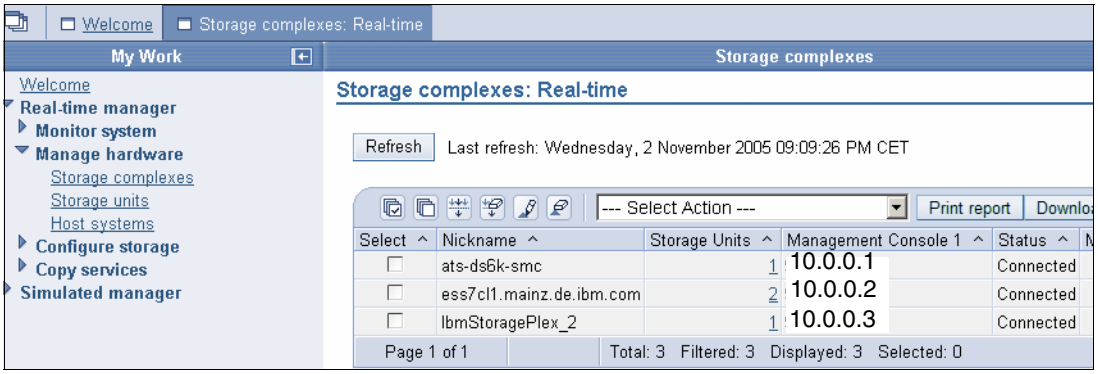

Figure 28-3 DS6000 GUI showing multiple complexes

8. Having added the DS8000 Storage Complex to the DS6000 Storage Complex, you are now able to use the DS6000 DS GUI to create paths and Remote Mirror and Copy pairs, where the DS8000 is the source device. You can also use the DS6000 DS GUI to manage FlashCopy pairs on the DS8000.

Note: The steps to add the DS8000 Storage Complex to the DS6000 Storage Complex cannot be performed with the DS CLI.

User ID management

There are two important considerations when you are managing multiple Storage Complexes from a single DS GUI:

- The user ID that you use to add the alternative complex must exist in both complexes. You must continue to use this user ID for all multi complex operations. If you log on to either DS GUI with a user ID that does not exist on the other Complex, the remote Complex will not appear in the Storage Complex panel.

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- Even when you have successfully added one complex to another, new user IDs created in one complex do not mirror to the other complex. They must be manually created and managed in each complex.

Storage management

You cannot use the DS8000 DS GUI to perform storage configuration on a DS6000. Likewise, you cannot use the DS6000 DS GUI to perform storage configuration on a DS8000. You can only perform Copy Services management tasks on the alternative device. If you are logged on to the DS6000 DS GUI and wish to configure some storage on the DS8000, you must log off and then log on to the DS8000 DS GUI. The same applies if you are logged on to the DS8000 DS GUI and wish to configure storage on the DS6000. You must log on to the DS6000 DS GUI to do this.

28.2.7 Volume size considerations for Remote Mirror Copy

When you use RMC (PPRC) to copy the contents of a CKD volume from one storage device to another, it is possible for the RMC target volume to be larger than the RMC source volume. However, if an attempt is made to reverse the relationship (so that the source becomes the target), this attempt will fail because now the source is larger than the target. Clearly the best way to avoid this is to ensure the source and target are exactly the same size.

28.2.8 Determining DS6000 and DS8000 CKD volume size

When CKD volumes are created on a DS6000 or DS8000, the size must be specified in cylinders. In Example 28-3, two CKD volumes of 3339 cylinders are created. This means that if we use these volumes in a PPRC relationship, their partner volumes should also be 3339 cylinders.

Example 28-3 CKD volume size in DS CLI

```
dscli> mkckdvol -extpool P2 -cap 3339 -name av_6K_CKD_#h 0600-0601
Date/Time: 8 November 2005 22:58:31 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00021I mkckdvol: CKD Volume 0600 successfully created.
CMUC00021I mkckdvol: CKD Volume 0601 successfully created.
dscli> lsckdvol -lcu 06
Date/Time: 9 November 2005 3:58:42 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
Name           ID   accstate datastate configstate deviceMTM voltype  orgbvols extpool cap (cyl)
==========================================================================================
av_6K_CKD_0600 0600 Online   Normal    Normal      3390-3    CKD Base -        P2           3339
av_6K_CKD_0601 0601 Online   Normal    Normal      3390-3    CKD Base -        P2           3339
```

28.3 RMC: Establishing paths between DS6000 and DS8000

To create a PPRC relationship between a DS8000 and an DS6000, you must first create logical paths (over the physical Fibre Channel connections). If you are using the DS GUI, then provided you added the other machines Storage Complex, you can establish paths in either direction (DS6000 to DS8000 or DS8000 to DS6000).

28.3.1 Decoding port IDs

When viewing port IDs in the DS GUI or DS CLI, the port IDs can be decoded to show which physical port on the DS8000 or DS6000 is in use.

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For DS8000, port IDs look like I0000 or I0123, which actually breaks out as IEECP. The EE is the enclosure number (minus 1), C is the card slot number (minus 1), and P is the port number on the card. So I0123 is enclosure 2 (1+1), slot 3 (2+1), port 3.

For DS6000, port IDs range from I0000 to I0001 and I0100 to I0103, which actually breaks out as IEECP. The EE is the controller number (00 or 01), C is the card slot number (always zero), and P is the port number on the card (0 to 3). So I0103 is controller 1, card slot 0, port 3.

28.3.2 Path creation using the DS GUI

Path creation between a DS6000 and a DS8000 is no different from the process that is used to create paths between two DS8000s or two DS6000. See 13.4, “Metro Mirror paths and links” on page 142.

Paths in the reverse direction

The previous example showed how to create a path from the DS8000 to the DS6000. In many cases, it is likely that you will need paths from DS6000 to the DS8000. Regardless, having established paths in one direction you can then establish paths in the opposite direction. Fibre Channel allows bi-directional mirroring over the same physical path.

Adding or deleting paths

You can add additional paths to an LSS pair by simply creating more paths. To remove a path, open the Paths panel, select the relevant source machine and LSS, select the path you wish to delete, and use the delete option from the Select Action menu.

28.3.3 Establish logical paths between DS8000 and DS6000 using DS CLI

You can use the DS CLI to establish logical paths. However, you must know the WWNN of the target Storage Image. The three commands we will use to establish a path are: **`lssi`**, **`lsavailpprcport`** and **`mkpprcpath`**.

Determining the remote device WWNN

If you started DS CLI by connecting to the DS8000 HMC, then the remote storage device is the DS6000. If you started DS CLI by connecting to the DS6000, then the remote Storage Image is the DS8000.

How to determine the DS6000 WWNN using the DS GUI

1. Click **Real-time manager**.
2. Click **Manage hardware**.
3. Click **Storage units**.
4. Click in the **Select** column for the DS6000 Storage Unit, and from the Select Action menu, select **Properties**.
5. The DS6000 Storage Unit WWNN is displayed in the subsequent properties panel.

Determining the DS6000 WWNN with the DS CLI

In Example 28-5, we show how to display the WWNN of a Storage Image using the **`lssi`** command.

Example 28-4 Determine the WWNN of a DS6000

```
dscli> lssi
Date/Time: 3 November 2005 1:05:50 IBM DSCLI Version: 5.1.0.204
```


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```
Name ID               Storage Unit     Model WWNN             State  ESSNet
==============================================================================
-    IBM.1750-1300247 IBM.1750-1300247 511   500507630EFFFE16 Online Enabled
```

Determining the DS8000 WWNN with the DS GUI

To determine the DS8000 WWNN with the DS GUI:

1. Click **Real-time manager**.
2. Click **Manage hardware**.
3. Click **Storage images** (not the Storage Unit).
4. Click in the **Select** column for the DS8000 Storage Image, and from the Select Action menu, select **Properties**.
5. The DS8000 Storage Image WWNN is displayed in the subsequent properties panel.

Determining the DS8000 WWNN with the DS CLI

In Example 28-5 we show how to display the WWNN of a DS8000 Storage Image using the **lssi** command.

Example 28-5 Determine the WWNN of a DS8000

```
dscli> lssi IBM.2107-7503461
Date/Time: 1 November 2005 3:08:52 IBM DSCLI Version: 5.1.0.204
Name ID               Storage Unit     Model WWNN             State  ESSNet
==============================================================================
-    IBM.2107-7503461 IBM.2107-7503460 932   5005076303FFC08F Online Enabled
```

Listing the available ports using the DS CLI

Having determined the remote devices WWNN, we can now display the ports that are available to establish PPRC paths. In Example 28-6 we are logged onto the DS8000 using DS CLI, so the remote device is the DS6000. We display ports available to establish paths between LSS 14 on the DS8000 and LSS 18 on the DS6000.

Note: When using the **lsavailpprcport** command you must specify LSSs that actually exist.

Example 28-6 Displaying available ports for PPRC path establishment

```
dscli> lsavailpprcport -remotedev IBM.1750-1300247 -remotewwnn 500507630EFFFE16 08:06
Date/Time: 8 November 2005 23:07:38 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
Local Port Attached Port Type
============================
I0001      I0103         FCP
I0131      I0003         FCP
```

Establishing the logical paths using DS CLI

Having determined which ports are available for each LSS pair that you wish to copy and mirror between, you now establish a one-way path using the **mkpprcpath** command. You can then display established paths using the **lspprcpath** command.

In Example 28-7, we first established a single path between LSS 14 on the DS8000 and LSS 18 on the DS6000. We then displayed the paths available for LSS 14 on the DS8000.

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Example 28-7 Using DS CLI to establish PPRC paths

```
dscli> mkpprcpath -remotedev IBM.1750-1300247 -remotewwnn 500507630EFFFE16 -srclss 14
-tgtlss 18 I0001:I0103
Date/Time: 3 November 2005 20:37:09 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00149I mkpprcpath: Remote Mirror and Copy path 14:18 successfully established.
dscli> lspprcpath 14
Date/Time: 3 November 2005 20:37:14 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
Src Tgt State   SS   Port  Attached Port Tgt WWNN
=========================================================
14  18  Success FF18 I0001 I0103         500507630EFFFE16
```

In Example 28-8, we added an additional path between LSS 14 on the DS8000 and LSS 18 on the DS6000. Not that we included the existing path when creating a new path. Otherwise the existing path is removed and only the new path will be available for use.

Example 28-8 Establishing additional paths using DS CLI

```
dscli> mkpprcpath -remotedev IBM.1750-1300247 -remotewwnn 500507630EFFFE16 -srclss 14
-tgtlss 18 I0001:I0103 I0131:I10003
Date/Time: 3 November 2005 20:37:49 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00149I mkpprcpath: Remote Mirror and Copy path 14:18 successfully established.
dscli> lspprcpath 14
Date/Time: 3 November 2005 20:37:53 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
Src Tgt State   SS   Port  Attached Port Tgt WWNN
=========================================================
14  18  Success FF18 I0001 I0103         500507630EFFFE16
14  18  Success FF18 I0131 I0003         500507630EFFFE16
```

To establish paths where the DS6000 is the source, connect to the DS6000 with the DS CLI and follow the same process, but specify the DS8000 as the remote device.

Important: When you connect using the DS CLI to the DS8000 HMC, the DS8000 is the local device and the DS6000 is the remote device. If you connect with the DS CLI to the DS6000, then the DS6000 is now the local device and the DS8000 is the remote device.

Attention: The **rmpprcpath** command removes all paths between the source and target LSSs. To just reduce the path count, use the **mkpprcpath** command and specify only the paths you wish to continue using.

28.3.4 Path creation using TSO

In Example , we established Metro Mirror paths from a DS6000 to a DS8000 with a TSO command. CESTPATH commands

```
/* ------------------------------------------------------------------ */
/*                                                                    */
/* ISSUE PPRC CESTPATH TO ESTABLISH PPRC PATHS                        */
/*                                                                    */
/* ------------------------------------------------------------------ */
 CESTPATH DEVN(X'E200') PRIM(X'6000' 500507630EFFFE16 X'06') -
          SEC(X'2105' 5005076303FFC08F X'05') -
          LINK(X'00030003' X'01030103') -
          CGROUP(NO)
/* ------------------------------------------------------------------ */
```


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The command breaks out as follows:

Device that command is issued to:E200
Primary LCU SSID: 6000
Primary DS6000 WWNN:500507630EFFFE16
Primary DS6000 LSS ID:06
Secondary DS8000 LCU SSID:2105
Secondary DS8000 WWNN:5005076303FFC08F
Secondary DS8000 LSS ID:05
First path established: I0003 to I0003
Second path established:I0103 to I0103

28.4 Managing Metro Mirror or Global Copy pairs

Having established paths, you can now establish volume pairs.

28.4.1 Managing Metro Mirror or Global Copy pairs with the DS GUI

Establishing and managing Metro Mirror and Global Copy pairs between a DS6000 and a DS8000 using the DS GUI is no different than using the DS GUI to establish pairs between two DS8000s or DS6000s. See 14.6, “DS Storage Manager GUI” on page 172 and Chapter 3, “DS Storage Manager” on page 17.

28.4.2 Managing Metro Mirror pairs using the DS CLI

In this example, we show how you can establish Metro Mirror volume pairs between a DS8000 and a DS6000 with the DS CLI. We created two Metro Mirror pairs. Volumes 0801 and 0802 from the DS8000 are the source volumes, and the target volumes on the DS6000 are 0601 and 0602.

Example 28-9 shows how we created two pairs with the **mkpprc** command. We then listed them with the **lspprc** command and removed one pair using the **rmpprc** command.

Example 28-9 Creating Metro Mirror pairs using DS CLI

```
dscli> mkpprc -remotedev IBM.1750-1300247 -type mmir -mode full 0801:0601 0802:0602
Date/Time: 9 November 2005 2:40:32 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0801:0601 successfully
created.
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0802:0602 successfully
created.
dscli> lspprc 0801-0802
Date/Time: 9 November 2005 2:40:38 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
ID        State        Reason Type         SourceLSS Timeout (secs) Critical Mode First
==========================================================================================
0801:0601 Copy Pending -      Metro Mirror 08        unknown        Disabled      Invalid
0802:0602 Copy Pending -      Metro Mirror 08        unknown        Disabled      Invalid
dscli> rmpprc -remotedev IBM.1750-1300247 0801:0601
Date/Time: 9 November 2005 2:41:18 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00160W rmpprc: Are you sure you want to delete the Remote Mirror and Copy volume pair
relationship 0801:0601:? [y/n] y
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 0801:0601 relationship successfully
withdrawn.
dscli>
```


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In Example 28-9 on page 425, we connected to the DS8000 HMC with the DS CLI, so the DS6000 is the remote device. To establish pairs where the DS6000 is the source device, we must connect to the DS6000 with DS CLI. This makes the DS8000 the remote device.

Important: If you specify the wrong **-remotedev** or you are using a profile where a remote device that is not the remote device that you want to use is specified, you might get an error message, CMUN03057, that you are specifying an invalid subsystem ID. This might be because you are specifying the wrong remote device serial number. If you have multiple possible remote devices, do not place a remotedev entry in your DS CLI profile.

28.4.3 Managing Global Copy pairs usingthe DS CLI

In this example, we show how you can establish Global Copy volume pairs between a DS8000 and a DS6000 with the DS CLI. We create two Global Copy pairs. Volumes 0801 and 0802 from the DS8000 are the source volumes, and the target volumes on the DS6000 are 0600 and 0601.

In Example 28-9 on page 425, we created two pairs using the **mkpprc** command. We then listed them using the **lspprc** command and paused one pair with the **pausepprc** command.

Example 28-10 Using DS CLI to manage Global Copy

```
dscli> mkpprc -remotedev IBM.1750-1300247 -type gcp 0801:0601 0802:0602
Date/Time: 9 November 2005 2:43:39 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0801:0601 successfully
created.
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0802:0602 successfully
created.
dscli> lspprc 0801-0802
Date/Time: 9 November 2005 2:43:46 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
ID        State        Reason Type        SourceLSS Timeout (secs) Critical Mode First Pass
==========================================================================================
0801:0601 Copy Pending -      Global Copy 08        unknown        Disabled      False
0802:0602 Copy Pending -      Global Copy 08        unknown        Disabled      False
dscli> pausepprc -remotedev IBM.1750-1300247 0801:0601
Date/Time: 9 November 2005 2:44:04 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00157I pausepprc: Remote Mirror and Copy volume pair 0801:0601 relationship
successfully paused.
dscli> lspprc 0801
Date/Time: 9 November 2005 2:44:08 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
ID        State     Reason      Type        SourceLSS Timeout (secs) Critical Mode First
==========================================================================================
0801:0601 Suspended Host Source Global Copy 08        unknown        Disabled      False
```

28.5 Managing DS6000 to DS8000 Global Mirror

The establishment of Global Mirror between a DS8000 and an DS6000 is achieved with the same methods explained in Chapter 26, “Global Mirror examples” on page 341.

28.5.1 Managing Global Mirror pairs using DS CLI

In Example 28-11, we established a Global Copy pair between volume 0601 on the DS6000 and volume 0801 on the DS8000. Next, we created session 90 for LSS 08. We then created a Global Mirror using session 90 and LSS 08.

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Example 28-11 Establishing Global Mirror using DS CLI

```
dscli> mkpprc -remotedev IBM.1750-1300247 -type gcp -tgtread -mode full 0801:0601
Date/Time: 9 November 2005 2:45:53 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0801:0601 successfully created.
dscli> lspprc 0801
Date/Time: 9 November 2005 2:46:04 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
ID        State        Reason Type        SourceLSS Timeout (secs) Critical Mode First Pass Status
=============================================================================================
0801:0601 Copy Pending -      Global Copy 08        unknown        Disabled      False
dscli> mkremoteflash -dev IBM.1750-1300247 -conduit IBM.2107-7503461 -record -nocp 0601:0602
Date/Time: 2 November 2005 21:49:00 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00173I mkremoteflash: Remote FlashCopy volume pair 0601:0602 successfully created. Use the
lsremoteflash command to determine copy completion.
dscli> mksession -lss 08 -volume 0801 90
Date/Time: 9 November 2005 2:57:18 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00145I mksession: Session 90 opened successfully.
dscli> lssession 08
Date/Time: 9 November 2005 2:57:55 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
LSS ID Session Status Volume VolumeStatus PrimaryStatus        SecondaryStatus   FirstPassComplete
=============================================================================================================
08     90      Normal 0801   Join Pending Primary Copy Pending Secondary Simplex True
dscli> mkgmir -lss 08 -session 90
Date/Time: 9 November 2005 2:58:19 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00162I mkgmir: Global Mirror for session 90 successfully started.
ddscli> showgmir 08
Date/Time: 9 November 2005 2:58:42 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
ID                         IBM.2107-7503461/08
Master Count               1
Master Session ID          0x90
Copy State                 Running
Fatal Reason               Not Fatal
CG Interval (seconds)      0
XDC Interval(milliseconds) 50
CG Drain Time (seconds)    30
Current Time               11/09/2005 02:59:58 EST
CG Time                    11/09/2005 02:59:58 EST
Successful CG Percentage   100
FlashCopy Sequence Number  0x4370CB7E
Master ID                  IBM.2107-7503461
Subordinate Count          0
Master/Subordinate Assoc   -
```

28.6 Managing DS6000 and DS8000 FlashCopy

The establishment of a FlashCopy pair on a DS6000 using the DS8000 DS GUI is no different than establishing a DS8000 FlashCopy pair (see 9.6, “FlashCopy management using the DS SM” on page 87. The establishment of a FlashCopy pair on a DS8000 using the DS6000 DS GUI, is again no different than establishing a DS6000 FlashCopy pair. For the DS CLI, you connect directly to the relevant SMC or HMC, so it is also not different.

28.6.1 Creating a remote FlashCopy on an DS6000 using DS CLI

It is also possible to use DS CLI to create a remote FlashCopy on a DS6000 where the source PPRC device is a DS8000 and vice versa. In Example 28-12, we connected to a DS8000 using the DS CLI. We determined that there are established paths from LSS 08 on the DS8000 to LSS 06 on the DS6000. We created a Metro Mirror pair from volume 0801 on

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the DS8000 to volume 0601 on the DS6000. We then created a remote FlashCopy on the DS6000 between DS6000 volumes 0601 and 0602. We then removed the remote FlashCopy.

Example 28-12 Creating a remote FlashCopy where the DS6000 is the remote target

```
dscli> lspprcpath 08
Date/Time: 9 November 2005 3:01:10 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
Src Tgt State   SS   Port  Attached Port Tgt WWNN
=========================================================
08  06  Success 6000 I0001 I0103         500507630EFFFE16
ddscli> mkpprc -remotedev IBM.1750-1300247 -type mmir 0801:0601
Date/Time: 9 November 2005 3:02:36 IBM DSCLI Version: 5.1.0.204 DS: IBM.2107-7503461
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0801:0601 successfully created.
dscli> mkremoteflash -dev IBM.1750-1300247 -conduit IBM.2107-7503461/08 -persist -nocp 0601:0602
Date/Time: 3 November 2005 22:35:45 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00173I mkremoteflash: Remote FlashCopy volume pair 0601:0602 successfully created. Use the
lsremoteflash command to determine copy completion.
dscli> lsremoteflash -dev IBM.1750-1300247 -conduit IBM.2107-7503461/08 0601:0602
Date/Time: 9 November 2005 3:04:07 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
ID        SrcLSS SequenceNum ActiveCopy Recording Persistent Revertible SourceWriteEnabled
=============================================================================================================
0601:0602 06     0           Disabled   Enabled   Enabled    Disabled   Enabled
dscli> rmremoteflash -dev IBM.1750-1300247 -conduit IBM.2107-7503461/08 0601:0602
Date/Time: 3 November 2005 22:36:19 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00179I rmremoteflash: Are you sure you want to remove the remote FlashCopy pair {0}? [y/n]:y
CMUC00180I rmremoteflash: Removal of the remote FlashCopy volume pair 0601:0602 has been initiated
successfully. Use the lsremoteflash command to determine when the relationship is deleted.
```

You could also reverse the scenario and use the DS6000 as the source machine in a PPRC pair and then create the remote FlashCopy on the DS8000.

Note: Commands that work with remote FlashCopies use the **-dev** parameter to define the server on which the FlashCopy is to be performed. Other commands, such as **mkpprc** commands, refer to this same device as the remote device, using **-remotedev**. However, because a FlashCopy must be sent to the remote site and then performed locally on that site, the use of the **-dev** parameter to refer to the remote machine is correct.

28.7 z/OS Global Mirror

Using a DS8000 as the primary Storage Unit and a DS6000 as a secondary Storage Unit is a supported configuration for the purposes of z/OS Global Mirror. However, the authors did not test it for this book. More importantly, if you plan to use z/OS Global Mirror, be aware that a z/OS Global Mirror environment that includes a DS8000 as a primary Storage Unit and a DS6000 as a secondary Storage Unit is not recommended for failover and failback operations because of the following limitations.

Performance mismatch (mirroring)

If the secondary Storage Unit, the DS6000, and its connectivity to the SDM that runs on z/OS Global Mirror, is significantly less capable (lower performing) than the primary Storage Unit and its connectivity to the application systems, the overall z/OS Global Mirror performance may suffer. That is, if applications can write faster to primary Storage Units than the SDM can write to the secondary Storage Units, then implementations problems can result. (The SDM is the function that copies data from the primary Storage Unit to the secondary Storage Unit in a z/OS Global Mirror environment.)

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Performance mismatch (running applications)

Suppose a disaster or failure occurs and applications failover to the secondary (or recovery) site and are running using the secondary Storage Units. If the secondary Storage Unit, the DS6000, is less capable (in performance) than the primary Storage Unit, it is likely that you will not be able to complete primary business applications in the required or expected time frame.

z/OS Global Mirror-capable local (or primary) Storage Units

Suppose a disaster or failure occurs in a z/OS Global Mirror environment and applications failover to the secondary site and are running at the secondary site on the secondary Storage Units. Later, after the primary site has been repaired and is ready to resume as the primary site, the secondary Storage Unit can then use z/OS Global Mirror to failback to the primary site. However, for the failover and failback operations to work successfully, the secondary Storage Unit must be a Global Mirror-capable primary Storage Unit, which means it must be capable of being a Global Mirror primary Storage Unit. The DS6000 does not have the appropriate microcode functionality to be a Global Mirror-capable primary Storage Unit and, therefore, cannot be used to failback to the primary site.

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Part 8

Solutions

In this part we discuss solutions offered by IBM to assist you in the management, automation, and control of your Copy Services implementation on the DS6000. We provide an overview of the solutions, discuss the options available, and give some examples of using the solutions.

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Interoperability between DS6000 and ESS 800

In this chapter we show the interoperability between the Copy Services functions in the DS8000 and the ESS 800. This chapter contains the following sections:

Sections in this chapter include:

- DS6000 and ESS 800 Copy Services interoperability
- Preparing the environment
- RMC: Establishing paths between DS6000 and ESS 800
- Managing Metro Mirror or Global Copy pairs
- Managing ESS 800 Global Mirror
- Managing ESS 800 FlashCopy

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29.1 DS6000 and ESS 800 Copy Services interoperability

Copy Services operations are supported between the DS6000 and the ESS 800 and Model 750. For the rest of this chapter, all references to the ESS 800 also apply to the ESS 750. On the ESS 800, RMC is called PPRC. All references to PPRC are interchangeable with RMC.

29.2 Preparing the environment

Before starting Copy Services operations in a mixed DS6000 and ESS 800 environment, you must ensure that this environment is set up correctly.

29.2.1 Minimum microcode levels

To manage the ESS 800 Copy Services from the DS6000, you must have your IBM Service Representative install licensed internal code Version 2.4.3.65 or higher on the ESS 800, and DS6000 code bundle 6.0.600.9 or higher on the DS6000.

29.2.2 Hardware and licensing requirements

To establish PPRC pairs between an ESS 800 and a DS6000, the ESS 800 must have a PPRC license and the DS6000 must have an RMC license.

The ESS 800 must also have Fibre Channel adapters that can connect to the DS6000. ESCON adapters cannot be used to mirror an ESS 800 to a DS6000. You cannot have a Copy Services relationship between a 2105 E20 or F20 and a DS6000. You could, however, have a cascaded installation where an ESS F20 is mirrored to an ESS 800 that is then mirrored to a DS6000. The ESS F20 to ESS 800 relationship must, however, be managed with ESS management tools such as the ESS CLI or the ESS Web Copy Services GUI.

z/OS Global Mirror RMZ (formerly XRC)

The DS6000 cannot be used as a Global Mirror primary Storage Unit. There is consequently no feature code for z/OS Global Mirror (RMZ) for DS6000. The DS6000 can be used a secondary Storage Unit.

29.2.3 Network connectivity

Network connectivity requirements depend on how you want to manage the environment. If you plan to use System z interfaces like TSO or ICKDSF, there are no network connectivity requirements. The commands are sent inband by FICON. If, however, you plan to use the DS CLI or the DS GUI, your requirements are as follows:

- For FlashCopy management:
  - If you want to use the DS6000 DS GUI to manage FlashCopy on the ESS 800, then you need network connectivity between the DS6000 SMCs and the ESS 800 Copy Services servers.
  - If you want to be able to use the DS CLI to manage FlashCopy on the ESS 800, then you need network connectivity between the machine on which you are running the DS CLI and at least one of the ESS 800 Copy Services servers.
- For creating RMC/PPRC paths and pairs:
  - If you wish to use the ESS 800 as a PPRC source machine, then you need network connectivity to the ESS 800 Copy Services servers, either from a server running DS CLI or from the DS6000 SMC.

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- If he ESS 800 is going to be purely a remote target for PPRC, and you do not plan to use it as a source server or use DS GUI to manage the pairs and paths, then you do not need to have network connectivity to the ESS 800 Copy Services servers. This is because all path and pair establishment is done by connecting to the source server (which would be the DS6000). This setup is not recommended because it is less flexible.

29.2.4 Creating matching user IDs and passwords

When you want to use the DS CLI or DS GUI to perform Copy Services operations, you need to authenticate with a valid user ID and password. When you use the DS GUI to perform an operation requires it to issue a command to an ESS 800, it must authenticate with the ESS 800. To do this, it uses the DS user ID and password that you used to log on to the GUI. This means that this user ID and password must be defined in the ESS Specialist. This task needs to be manually performed. If instead of the DS GUI, you only use the DS CLI, then you are logging on to the ESS 800 Copy Services server directly and the DS user ID and password for the GUI is not necessary. For simplified management, you can still create a matching user ID and password.

Creating a user ID on the DS6000

Log on to the DS6000 SMC using the DS GUI and create a user ID that is in either the *admin*, *op_storage.* or *op_copy_services* groups. Log off and then log on with that user ID and change the initial password.

Creating a user ID on the ESS 800

Once you have created a DS user ID, you must create a matching user ID using the ESS 800 Web Specialist:

1. Start a Web browser and connect to the IP address of either ESS 800 cluster.
2. Click **ESS Specialist**.
3. Log on with a ESS Specialist user ID that has administrator privileges.
4. Click **Users**.
5. Click **Modify Users**. Type the user ID name and password that you created in the DS CLI or GUI. It must be given the *Administration* access level.
6. Click **Add** to move the user ID to the right hand box.
7. Click **Perform Configuration Update** and wait for the completion message.

Important: The ESS Web Copy Services user IDs are not used by the DS CLI or DS GUI. You only need to create a matching ESS Specialist user ID.

29.2.5 Updating the DS CLI profile

If you plan to use the DS CLI to manage your ESS 800, you can create a profile to simplify: connection, commands, and scripted operations. Add extra lines as shown in Example 29-1.

Example 29-1 Possible modification to a DS CLI profile

```
# ESS 800
# SMC1 is the Copy Services server A
SMC1: 10.0.0.100
# devid is the serial number of the ESS 800 - note there are only 5 digits after the 2105
devid: IBM.2105-22399
# remotedevid is the serial number of the DS6000
remotedevid: IBM.1750-1300247
```


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```
# Username is a user created on the ESS Specialist that matches the userid on the DS6000
 username:admin
# The password for the admin user id. Placing it here is not very secure.
password:passw0rd
# The password file is created using the managepwfile and is a better way to manage this.
# pwfile:security.dat
```

Putting the password in the profile is not very secure (because it is stored in plain text), but it can be more convenient. A password file can be created using the **managepwfile** command and is a better way to manage this. After creating the password file (which by default is called *security.dat*), you can remove the password from the profile and instead specify the pwfile file.

The command to create a passwd file in this example is:

```
managepwfile -action add -name admin -pw passw0rd
```

A simple method when you have multiple machines to manage is to create multiple profile files. Then, when you start the DS CLI, you can specify the profile file that you wish to use with the **-cfg** parameter. In a Windows environment, you can have multiple Windows batch files (BAT files), one for each machine you wish to manage. The profile shown in Example 29-1 on page 435 could be saved in the C:\program files\ibm\dscli\profile directory as 2105source.profile. Then you create a simple Windows BAT file with three lines, as shown in Example 29-2.

Example 29-2 Windows BAT file to start a specific profile

```
title DS CLI Local 2105-22399 Remote IBM.1750-1300247
cd C:\Program Files\ibm\dscli\profile
dscli -cfg 2105source.profile
```

We saved the BAT file on the Windows desktop and started it by double-clicking the icon. The DS CLI opened and started the specified profile. By creating a BAT file and profile for each machine, you can simplify the process of starting the DS CLI. You can also specify the profile when starting DS CLI from inside a script, or when running the DS CLI in script mode.

29.2.6 Adding the Copy Services domain

If you wish to use the DS GUI to manage FlashCopy on an ESS 800, or RMC paths and pairs between an ESS 800 and a DS6000, you must add the ESS Copy Services domain to the DS SMC. You need the IP address of the ESS 800 Copy Services servers (server A and if desired, server B). You can get these by connecting with a Web browser to either cluster of the ESS, and clicking the Copy Services tab. They will be displayed on the first window you see.

You add an ESS Copy Services domain with the DS Storage Manager to the DS6000 as follows:

1. Click **Real-time manager**.
2. Click **Manage hardware**.
3. Click **Storage complexes**.
4. Select **Add 2105 Copy Services Domain**.
5. Figure 29-1 on page 437 shows the Add 2105 Copy Services Domain panel that opens.

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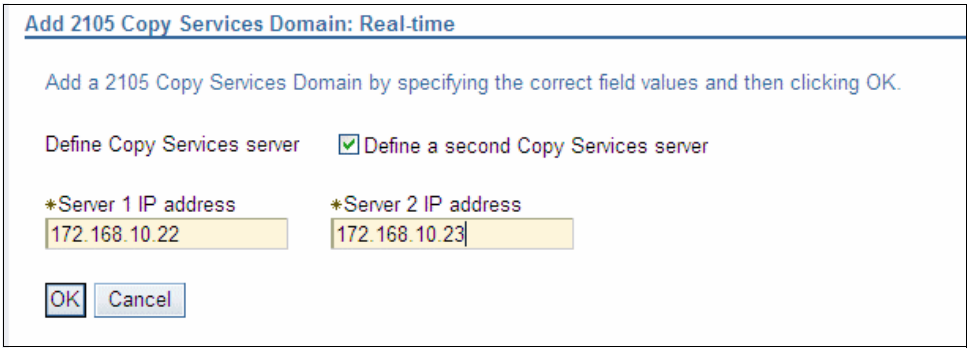
Add 2105 Copy Services Domain: Real-time
Add a 2105 Copy Services Domain by specifying the correct field values and then clicking OK.
Define Copy Services server
Define a second Copy Services server
*Server 1 IP address
172.168.10.22
*Server 2 IP address
172.168.10.23
OK
Cancel

Figure 29-1 Add 2105 Copy Services Domain

6. Enter the IP address of the ESS Copy Services server A in the Server 1 IP field. If you have a Server B, select **Define a second Copy Services server** and enter the Server B IP address in the Server 2 IP address. However, if Server B is running on a 2105-F20, you should not define it.

Having added the ESS 800 Copy Services domain to the DS GUI, you are now able to use the DS GUI to create paths and RMC pairs, where the ESS 800 is the source device. You can also use the DS GUI to manager FlashCopy pairs on the ESS 800.

Note: The steps to add the ESS 800 Copy Services Domain to a DS6000 cannot be performed using the DS CLI. However if you do not plan to use the GUI, this is not an issue.

Restriction: You cannot use the ESS Copy Services Server Web GUI to manage Copy Services relationships between an ESS 800 and a DS6000. The Volumes tab only shows ESS 800 volumes, not DS6000 volumes. The Paths tab does not show paths between an ESS 800 and a DS6000. It only shows paths between ESS 800s. If you are using PPRC between a DS6000 and an ESS 800, all management of that PPRC relationship must be done with DS CLI or via the DS GUI.

Storage management

You cannot use the DS6000 DS GUI to perform storage configuration on an ESS 800. Likewise you cannot use the ESS 800 Web Specialist to perform storage configuration on a DS6000. You can only perform Copy Services management tasks on the alternative device. If you are logged on to the DS6000 DS GUI and wish to configure some storage on the ESS 800, you must log on to the ESS 800 Web Specialist.

29.2.7 Volume size considerations for RMC (PPRC)

When using PPRC to copy the contents of a CKD volume from one storage device to another, it is possible for the PPRC target volume to be larger than the PPRC source volume. However, if an attempt is made to reverse the relationship so that the source becomes the target, then this attempt will fail because the source is now larger than the target. For this reason it is always recommended that the source and target volumes be the same size. Prior to creating a PPRC relationship, check the volumes sizes to ensure they are the same for each storage device.

Determining DS6000 and DS8000 CKD volume size

When CKD volumes are created on a DS6000 or DS8000, the size must be specified in cylinders. In Example 29-3, two CKD volumes of 3339 cylinders are created. This means that

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if you use these volumes in a PPRC relationship, their partner volumes should also be 3339 cylinders.

Example 29-3 CKD volume size in DS CLI

```
dscli> mkckdvol -extpool P2 -cap 3339 -name av_6K_CKD_#h 0600-0601
Date/Time: 8 November 2005 22:58:31 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00021I mkckdvol: CKD Volume 0600 successfully created.
CMUC00021I mkckdvol: CKD Volume 0601 successfully created.
dscli> lsckdvol -lcu 06
Date/Time: 9 November 2005 3:58:42 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
Name           ID   accstate datastate configstate deviceMTM voltype  orgbvols extpool cap (cyl)
==========================================================================================================
av_6K_CKD_0600 0600 Online   Normal    Normal      3390-3    CKD Base -        P2           3339
av_6K_CKD_0601 0601 Online   Normal    Normal      3390-3    CKD Base -        P2           3339
```

Determining ESS volume size

To view the ESS volume sizes, you can use the ESS Specialist.

1. Start a Web browser and connect to the IP address of either ESS 800 cluster.
2. Click **ESS Specialist**.
3. Log on with a ESS Specialist user ID.
4. Click the Storage Allocation tab.
5. Click the S/390 Storage tab.
6. Highlight the LCU that contains the volumes you wish to check.
7. Take note of the value in the cylinders column for the volumes that you are interested in as shown in Figure 29-2. In this example, the volumes are all 3339 cylinders in size.

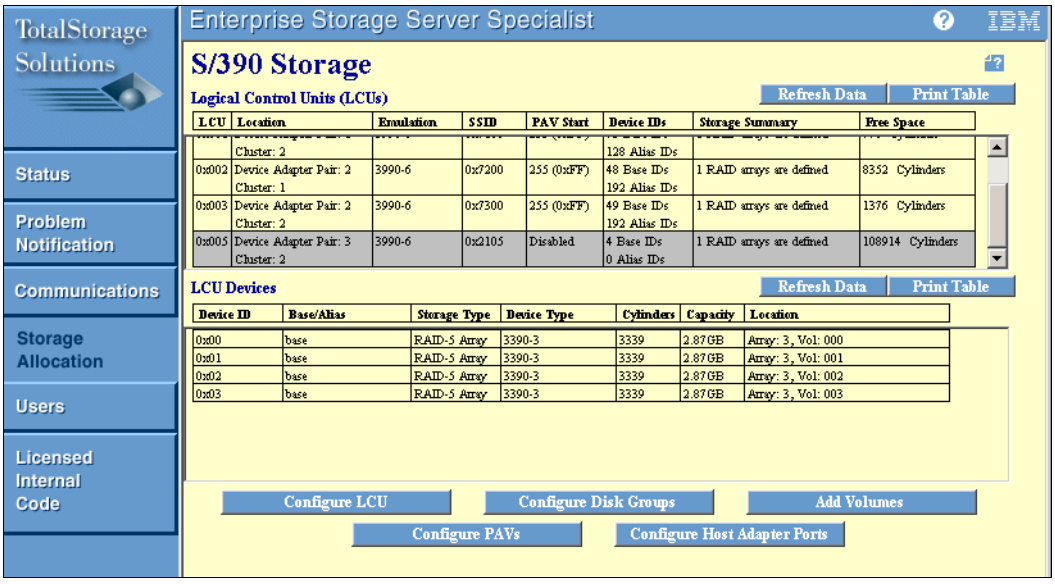

Figure 29-2 Viewing ESS 800 volume size using ESS Specialist GUI

You can also use the ESS CLI to view the volume size as shown in Example 29-4 on page 439.

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Example 29-4 Using ESS CLI to list CKD volumes

```
C:\Program Files\ibm\ESScli>esscli -u copy -p serv1ces -s 9.155.51.237 list volume
Wed Nov 09 04:07:52 EST 2005 IBM ESSCLI 2.4.0
Volume    Cap  Units  VolType  LSS  VS    Serial    Label
------  -----  -----  -------  ---  ----  --------  -----
0500    3339  Cyls    3390     05  vs6   ***       ***
0501    3339  Cyls    3390     05  vs6   ***       ***
0502    3339  Cyls    3390     05  vs6   ***       ***
0503    3339  Cyls    3390     05  vs6   ***       ***
```

Note: You cannot use the DS CLI to check volume sizes on an ESS 800. You must either use the ESS Specialist or the ESS CLI.

29.2.8 Volume address considerations on the ESS 800

On the ESS 800, open systems volume IDs are given in an eight-digit format, xxx-sssss where xxx is the LUN ID and sssss is the serial number of the ESS 800. When referring to them in the DS CLI, you must add 1000 to the volume ID, so volume 000-22399 is volume ID 1000 and volume 001-22399 is volume ID 1001. This is very important because on the ESS 800, the following address ranges are actually used:

0000 to 0FFF	CKD volumes (4096 possible addresses)
1000 to 1FFF	Open systems fixed block LUNs (4096 possible addresses)

If we intend to use FlashCopy to copy ESS open systems LUN 000-22399 onto 001-22399 using DS CLI, we must specify 1000 and 1001. If instead, we specify 0000 and 0001, we actually run the FlashCopy against CKD volumes. This might result in an unplanned outage on the System z environment that was using CKD volume 0001.

29.3 RMC: Establishing paths between DS6000 and ESS 800

To create a PPRC relationship between a DS6000 and an ESS 800, you first must create logical paths (over the physical Fibre Channel connections). If you are using the DS GUI, then provided you added the ESS Copy Services Domain to the DS6000, you can establish paths in either direction (ESS 800 to DS6000 or DS6000 to ESS 800). If the ESS Copy Services domain was not added, then paths can only be established where the DS6000 is the source.

29.3.1 Decoding port IDs

When viewing port IDs in the DS GUI or DS CLI, you can decode the IDs to show which physical port on the DS6000 or ESS 800 is in use. For DS6000, port IDs range from I0000 to I0001 and I0100 to I0103. These break out as IEECP. The EE is the controller number (00 or 01), C is the card slot number (always 0), and P is the port number on the card (0 to 3). So I0103 is controller 1, card slot 0, port 3.

The ESS 800 port IDs do not follow the same rule. To decode them, take the last two digits in the port ID and then use Figure 29-3 on page 440. So port ID I0020 is the adapter in host bay 2, slot 1 and port ID I00AC is the adapter in host bay 4, slot 4.

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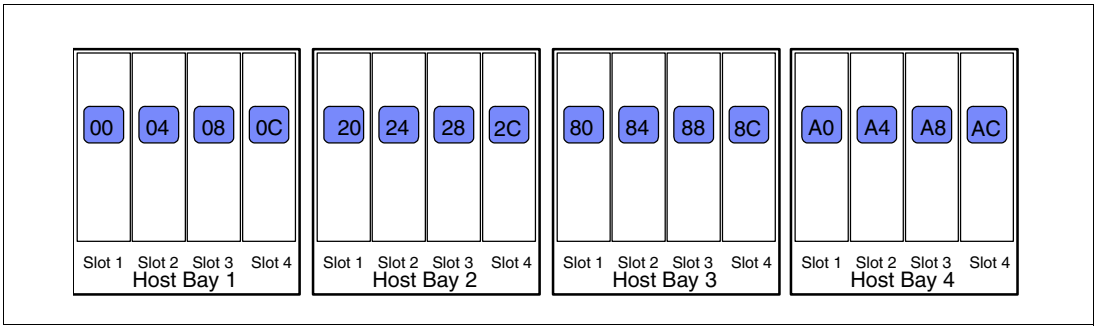

Figure 29-3 ESS 800 I/O ports decoded

29.3.2 Creating paths with the DS GUI

In this example, we show how to establish two PPRC paths from DS6000 LSS 06 to ESS LSS 05 with the DS Storage Manager.

Tip: CKD LCUs on an ESS 800 are always LSS 00 to LSS 0F. If you select ESS 800 LSS 10 to ESS 800 LSS 1F, you are working with open systems LSSs on the ESS 800.

1. Click **Real-time manager**.
2. Click **Copy Services**.
3. Click **Paths**.
4. Select the Storage complex, Storage unit, and Storage image from which you want to create PPRC paths. For this path, this server provides the source LSS.
5. Click **Create**. See Figure 29-4.

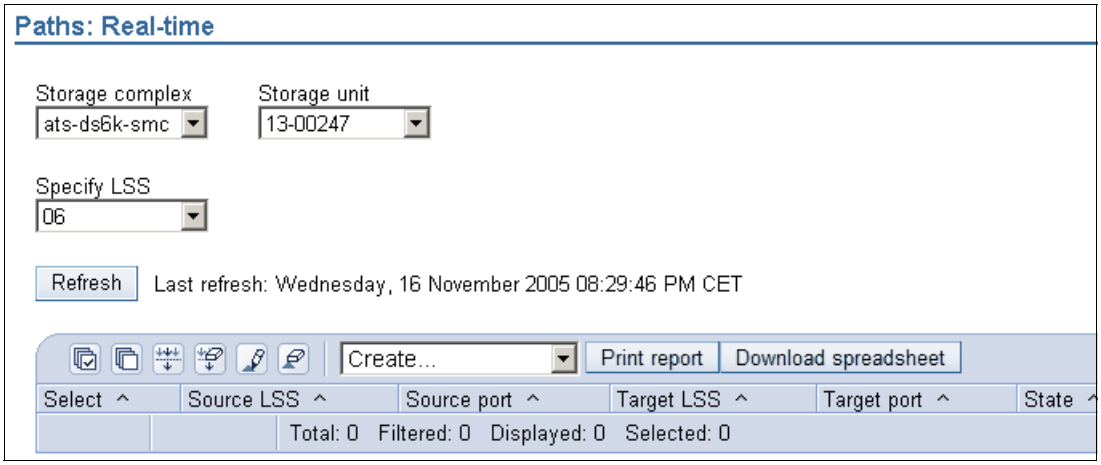

Figure 29-4 Path panel

6. In the panel that opens, select the source LSS of the DS6000 from which you want to establish the PPRC paths. Click **Next**. In this example, we wanted to establish PPRC paths from LSS 06 as shown in Figure 29-5 on page 441.

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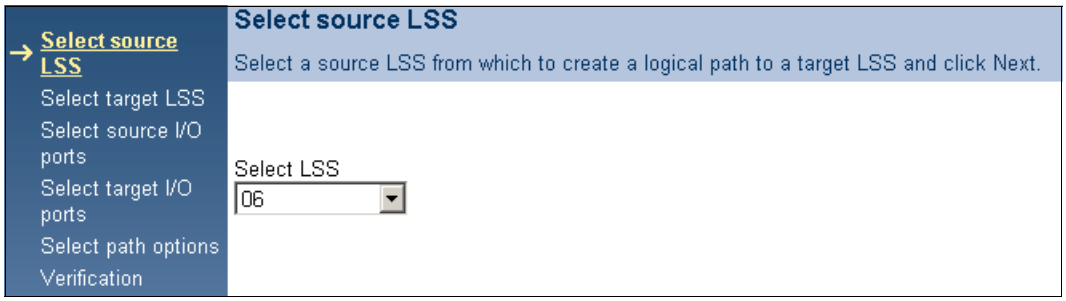
Select source LSS
Select target LSS
Select source I/O ports
Select target I/O ports
Select path options
Verification
Select source LSS
Select a source LSS from which to create a logical path to a target LSS and click Next.
Select LSS
06

Figure 29-5 Select source LSS

7. To specify the target LSS, select the Storage Complex for the ESS from the Storage Complex menu. Then, from the Storage Unit menu, select the appropriate Storage Unit and the LSS from the Storage Unit. When you are finished, click **Next** to continue. In Figure 29-6 the target LSS on the ESS is LSS 05.

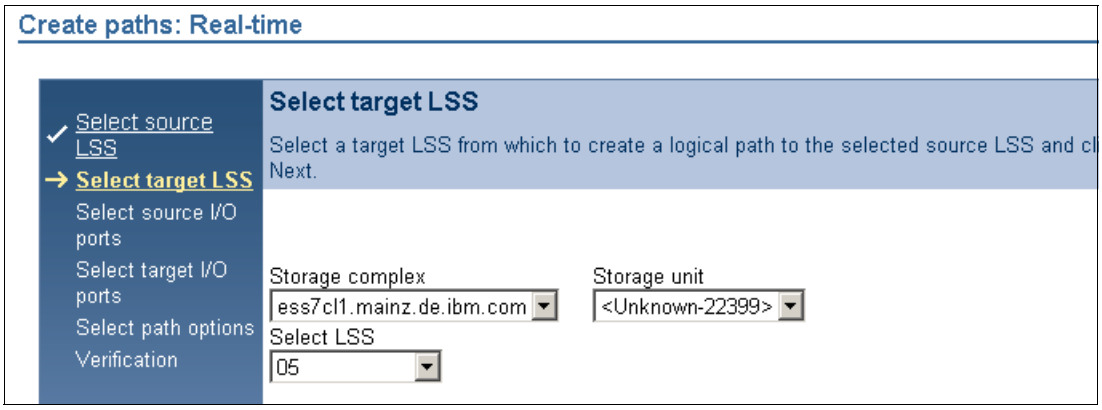

Figure 29-6 Select target LSS

8. The next panel shows you which Fibre Channel ports are available for establishing Metro Mirror and Copy paths (see Figure 29-7 on page 442). Select the ports and click **Next**. Because you want to establish two paths from the DS6000 to the ESS, you must select both I/O ports from the DS6000 that are available for RMC. You only see physical connections that actually exist. To get connections listed, the HBAs in the DS6000 and ESS 800 must be either be zoned together or directly connected.

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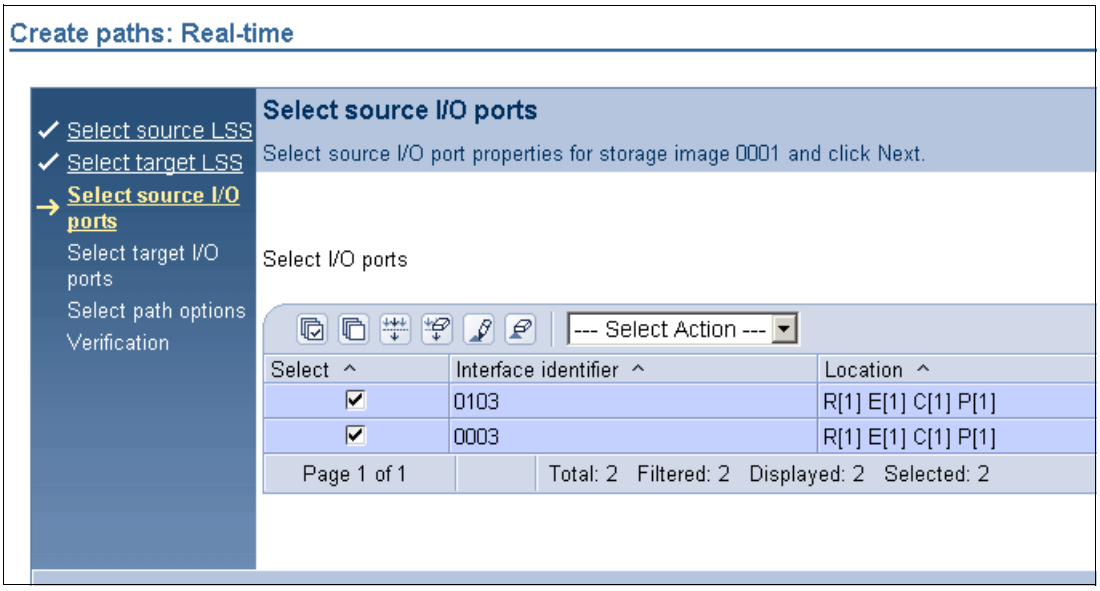

Figure 29-7 Select source I/O ports

9. In the next panel (see Figure 29-8), you select, for each source I/O port from the DS6000, a target I/O port on the ESS. When you are finished, click **Next**.

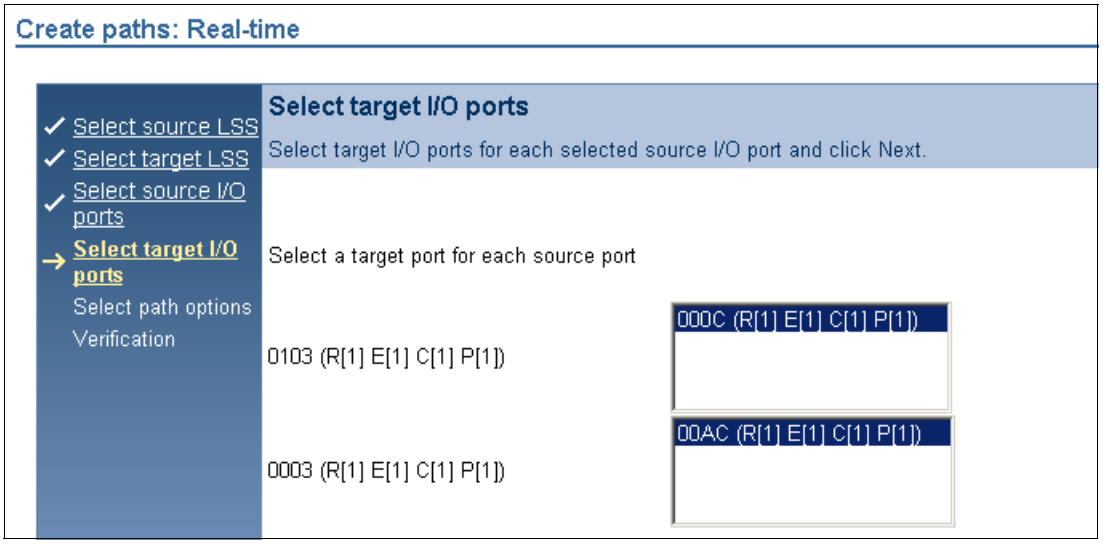
Create paths: Real-time
Select source LSS
Select target LSS
Select source I/O ports
Select target I/O ports
Select path options
Verification
Select target I/O ports
Select target I/O ports for each selected source I/O port and click Next.
Select a target port for each source port
0103 (R[1] E[1] C[1] P[1])
0003 (R[1] E[1] C[1] P[1])
000C (R[1] E[1] C[1] P[1])
00AC (R[1] E[1] C[1] P[1])

Figure 29-8 Select target I/O ports

10. In the next two panels, you are asked whether you want built a Consistency Group and to verify the information that you entered during the process. Verify the information and click **Finish** to establish the PPRC paths.

Figure 29-9 on page 443 shows the two PPRC paths that we have for LSS 06. To manage the established paths (for example, delete path), you can select the path you want to manage and then select the appropriate action you want to perform from the menu.

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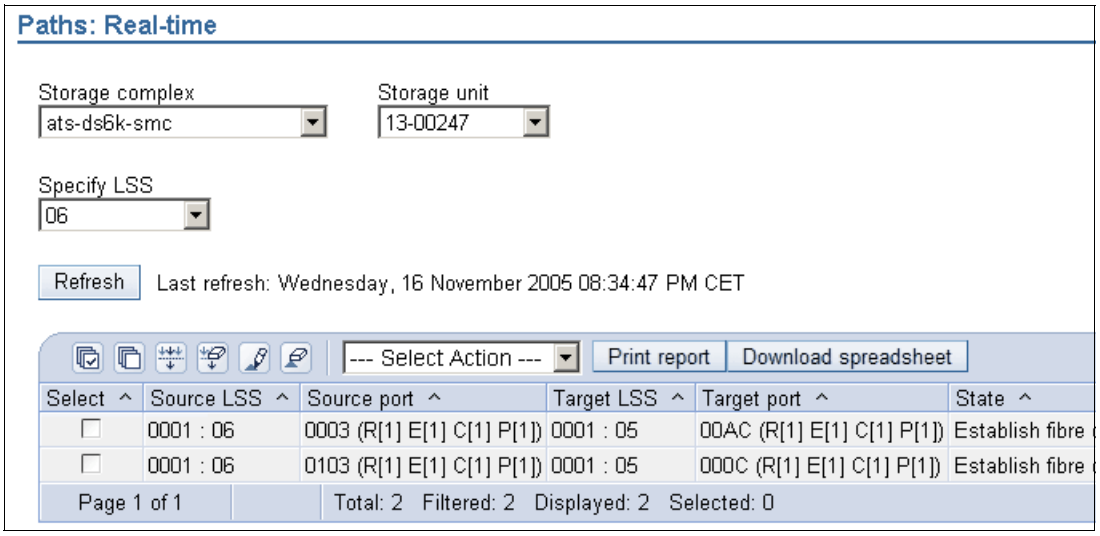

Figure 29-9 Path panel

Paths in the reverse direction

The previous example showed how to create a path from the DS6000 to the ESS 800. In many cases, it is likely that you will need paths from ESS 800 to the DS6000. Because you have established paths in one direction, you can now establish paths in the opposite direction. Fibre Channel allows bidirectional mirroring over the same physical path.

Adding or deleting paths

You can add additional paths to an LSS pair by simply creating more paths. To remove a path, open the Paths panel, select the relevant source server and LSS, select the path that you wish to delete, and use the delete option from the Select Action pull-down.

29.3.3 Establishing logical paths between DS6000 and ESS 800 using DS CLI

You can also use the DS CLI to establish logical paths. However, you must know the WWNN of the target Storage Image. The three commands you can use to establish a path are: **`lssi`**, **`lsavailpprcport`** and **`mkpprcpath`**.

Determining the remote device WWNN

First, we need to determine the WWNN of the remote storage device. If you started DS CLI by connecting to the DS6000 SMC, then the remote storage device is the ESS 800. If you started DS CLI by connecting to the ESS 800, then the remote Storage Image is the DS6000.

Determining the DS6000 WWNN with the DS GUI

To use the DS CUI to determine the DS6000 WWNN, follow these steps:

1. Click **Real-time manager**.
2. Click **Manage hardware**.
3. Click **Storage units**.
4. Click in the **Select** column for the DS6000 Storage Unit, and from the **Select Action** pull-down, choose **Properties**.
5. The DS6000 Storage Unit WWNN will be displayed on the subsequent properties panel.

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Determining DS6000 WWNN with DS CLI

In Example 29-5, we show how to display the WWNN of a Storage Image using the **lssi** command.

Example 29-5 Determine the WWNN of a DS6000

```
dscli> lssi
Date/Time: 3 November 2005 1:05:50 IBM DSCLI Version: 5.1.0.204
Name ID               Storage Unit     Model WWNN             State  ESSNet
==========================================================================
-    IBM.1750-1300247 IBM.1750-1300247 511   50050763OEFFFE16 Online Enabled
```

Determine the WWNN of the ESS 800 with the ESS Specialist

To determine the WWN of the ESS 800 with the ESS Specialist:

1. Point your browser to the IP address of either cluster of the ESS 800.
2. On the opening panel, click **ESS Specialist**.
3. Using the prompt, log on to the ESS Specialist with a ESS Specialist user ID and password.
4. On the welcome panel, you see the WWNN as shown in Figure 29-10. Write it down.

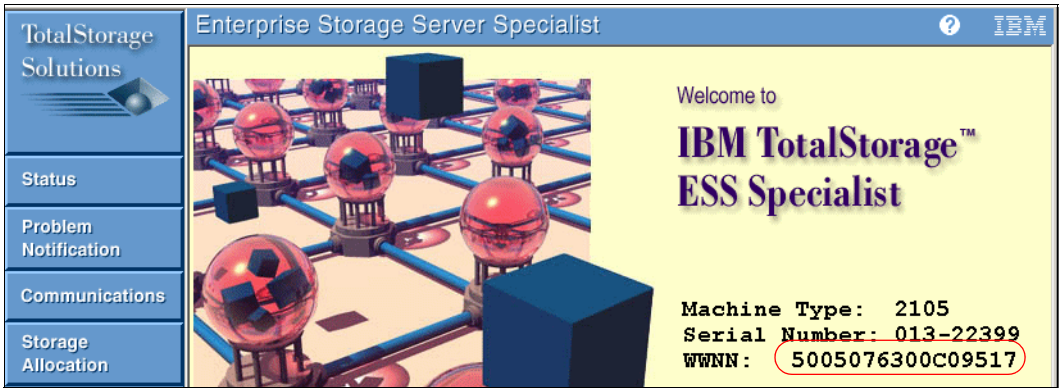

Figure 29-10 Using ESS 800 Specialist GUI to display the ESS 800 WWNN

Determining the WWNN of the ESS 800 using the ESS CLI

If you have the ESS CLI installed on a PC, then you can use the **list server** command to display the ESS 800 WWNN.

Note: This is not the DS CLI. ESS CLI is a separate software package that you can get from your IBM Service Representative if you do not already have it.

An example of the command syntax is shown in Example 29-6. The advantage of this technique is that you can copy and paste the output.

Example 29-6 Using ESS CLI to display the ESS 800 WWNN

```
C:\Program Files\ibm\ESScli>esscli -u storwatch -p specialist -s 10.0.0.1 list server
Tue Nov 01 03:28:59 EST 2005 IBM ESSCLI 2.4.0

  Server    Model  Mfg        WWN         CodeEC    Cache    NVS  Racks
-------------------------------------------------------------------------
2105.22399   800    013  5005076300C09517  2.4.3.79   32GB    2GB    1
```


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Listing the available ports using DS CLI

Having determined WWNN of the remote devices, we can now display the ports that are available for establishing PPRC paths. In Example 29-7, we are logged on to the DS6000 using DS CLI, so the remote device is the ESS 800.

Note: When using the **lsavailpprcport** command, you must specify LSSs that actually exist.

Example 29-7 Displaying available ports for PPRC path establishment

```
dscli> lsavailpprcport -remotedev IBM.2105-22399 -remotewwnn 5005076300C09517 06:05
Date/Time: 8 November 2005 23:13:47 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
Local Port Attached Port Type
=============================
I0003      I00AC         FCP
I0103      I000C         FCP
```

Note: When issuing commands that refer to an ESS 800, the ESS 800 serial number is only five digits, and not the seven you see for the DS6000 or DS8000. So, in our examples, the serial number syntax we use is IBM.2105-22399, not IBM.2105-1322399.

Establishing the logical paths using the DS CLI

Having determined which ports are available for each LSS pair that you wish to copy and mirror between, you now establish a one-way path with the **mkpprcpath** command. You can then display established paths using the **lspprcpath** command.

In Example 29-8, we established a single path between LSS 06 on the DS6000 and LSS 05 on the ESS 800 and then showed the paths available for LSS 06 on the DS6000.

Example 29-8 Using DS CLI to establish PPRC paths

```
dscli> mkpprcpath  -remotedev IBM.2105-22399 -remotewwnn 5005076300C09517 -srclss 06
-tgtlss 05 I0003:I00AC
Date/Time: 8 November 2005 23:28:53 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00149I mkpprcpath: Remote Mirror and Copy path 06:05 successfully established.
dscli> lspprcpath 06
Date/Time: 8 November 2005 23:29:12 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
Src Tgt State   SS   Port  Attached Port Tgt WWNN
=======================================================
06  05  Success 2105 I0003 I00AC         5005076300C09517
```

In Example 29-9, we add an additional path between LSS 06 on the DS6000 and LSS 05 on the ESS 800. Note that we include the existing path when creating a new path. Otherwise, the existing path is removed and only the new path will be available for use.

Example 29-9 Establishing additional paths using DS CLI

```
dscli> mkpprcpath  -remotedev IBM.2105-22399 -remotewwnn 5005076300C09517 -srclss 06
-tgtlss 05 I0003:I00AC I0103:I000C
Date/Time: 8 November 2005 23:30:18 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00149I mkpprcpath: Remote Mirror and Copy path 06:05 successfully established.
dscli> lspprcpath 06
Date/Time: 8 November 2005 23:30:27 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
Src Tgt State   SS   Port  Attached Port Tgt WWNN
```


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```
=======================================================
06  05  Success 2105 I0003 I00AC         5005076300C09517
06  05  Success 2105 I0103 I000C         5005076300C09517
```

To establish paths where the ESS 800 is the source, you should connect to the ESS 800 using the DS CLI and follow the same process, but specify the DS6000 as the remote device.

Important: When you connect using DS CLI to the DS6000 SMC, the DS6000 is the local device and the ESS 800 is the remove device. If you connect using DS CLI to the ESS 800, then ESS 800 is now the local device and the DS6000 is the remote device.

Attention: The **rmpprcpath** command removes all paths between the source and target LSSs. To just reduce the path count, use the **mkpprcpath** command and specify only the paths that you wish to continue using.

29.3.4 Creating paths using TSO

In Example 29-10, we established Metro Mirror paths from a DS6000 to an ESS 800 using a TSO command.

Example 29-10 CESTPATH command

```
/* ------------------------------------------------------------------ */
/*                                                                    */
/* ISSUE PPRC CESTPATH TO ESTABLISH PPRC PATHS                        */
/*                                                                    */
/* ------------------------------------------------------------------ */
 CESTPATH DEVN(X'E200') PRIM(X'6000' 500507630EFFFE16 X'06') -
          SEC(X'2105' 5005076300C09517 X'05') -
          LINK(X'000300AC' X'0103000C') -
          CGROUP(NO)
/* ------------------------------------------------------------------ */
```

The command breaks out as follows:

Device that command is issued to: E200
Primary LCU SSID: 6000
Primary DS6000 WWNN: 500507630EFFFE16
Primary DS6000 LSS ID: 06
Secondary ESS 800 LCU SSID: 2105
Secondary ESS 800 WWNN: 5005076300C09517
Secondary ESS 800 LSS ID: 05
First path established: I0003 to I00AC
Second path established: I0103 to I000C

29.4 Managing Metro Mirror or Global Copy pairs

Having established paths, we can now establish volume pairs.

29.4.1 Managing Metro Mirror or Global Copy pairs using the DS GUI

In this example, we show how you can establish Metro Mirror volume pairs between a DS6000 and an ESS 800 with the DS Storage Manager. In this example, we created two

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Metro Mirror pairs. Volumes 0600 and 0601 from the DS6000 are the source volumes, and the target volumes are 0500 and 0501 from the ESS 800. We followed the same method to set up a Global Copy pair, except that Global Copy is selected (Figure 29-16 on page 449):

1. Click **Real-time manager**.
2. Click **Copy services**.
3. Click **Metro Mirror**.
4. Select the Storage complex, Storage unit, and Storage image for the Metro Mirror source volumes.
5. Select **Create** (Figure 29-11).

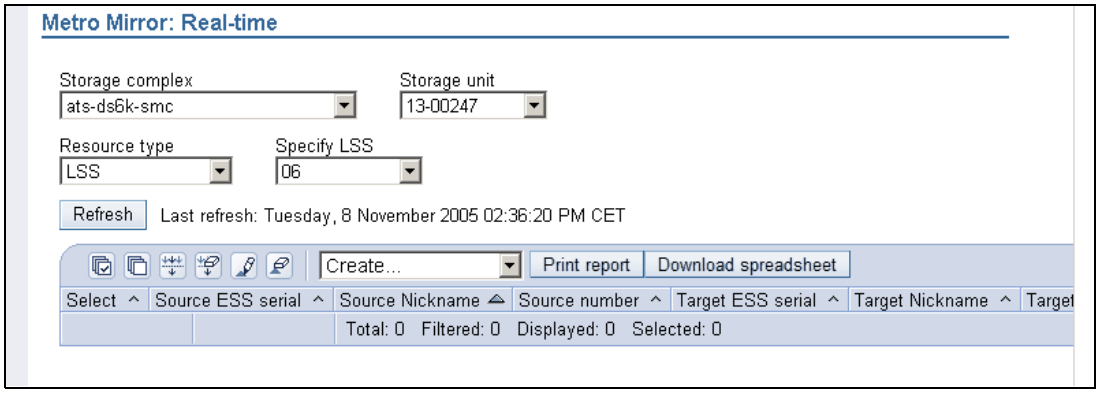

Figure 29-11 Metro Mirro

The next panels guide you through the process of creating Metro Mirror volume pairs. In the last panel, you have the opportunity to review the information you entered before you establish the Metro Mirror pairs. Also, during the process, you can, at any time, go back to modify specifications that you have already done, or you can cancel the process.

6. In the panel illustrated Figure 29-12, you have the option of selecting **Automated volume assignment** or **Manual volume pair assignment**;. If you click **Automated volume pair assignment**, the first selected source volume is paired automatically with the first selected target volume. If you click **Manual volume pair assignment**, you must select each specific target volume for each selected source volume. For this example, we assigned the volume pairs manually.

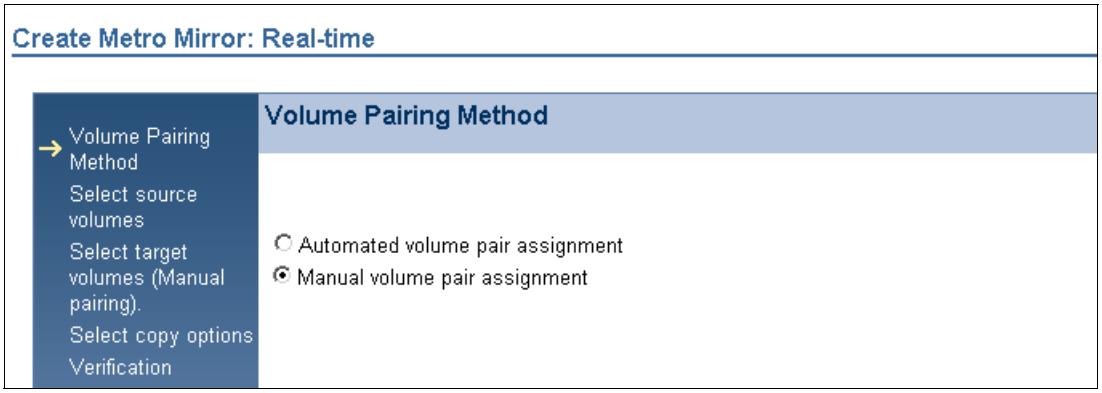

Figure 29-12 Pairing method

7. The source volumes we want ed to use are on the ESS 800 in LSS 10. We selected two volumes and clicked **Next** (see Figure 29-13 on page 448). Note that you also have the option of creating paths from this panel.

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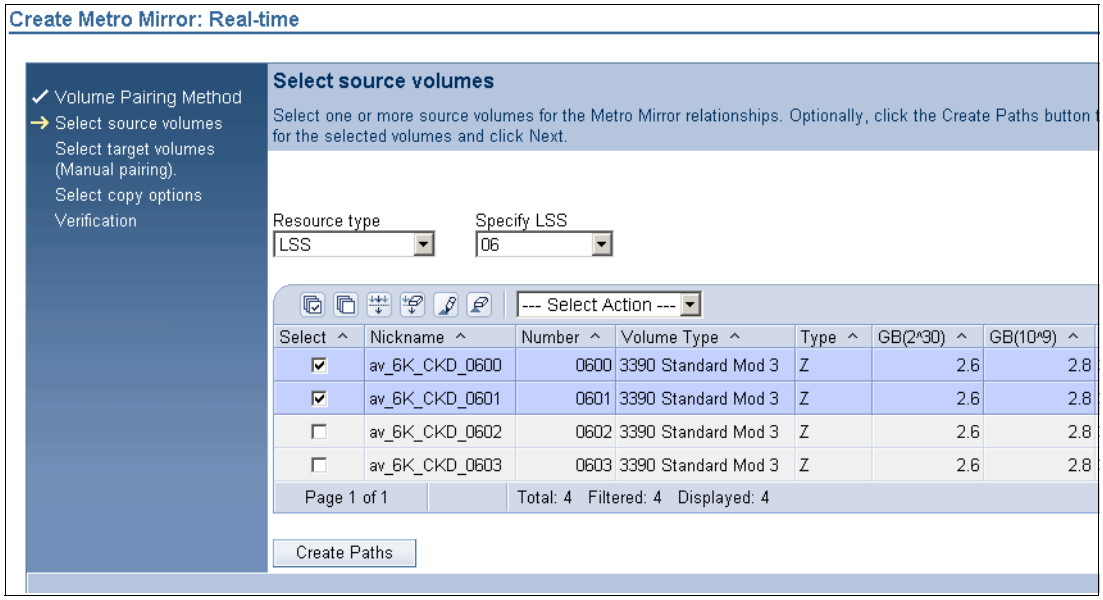
Create Metro Mirror: Real-time
Volume Pairing Method
Select source volumes
Select target volumes (Manual pairing).
Select copy options
Verification
Select source volumes
Select one or more source volumes for the Metro Mirror relationships. Optionally, click the Create Paths button t
for the selected volumes and click Next.
Resource type
LSS
Specify LSS
06
--- Select Action ---
Select
Nickname
Number
Volume Type
Type
GB(2^30)
GB(10^9)
av_6K_CKD_0600 0600 3390 Standard Mod 3 Z 2.6 2.8
av_6K_CKD_0601 0601 3390 Standard Mod 3 Z 2.6 2.8
av_6K_CKD_0602 0602 3390 Standard Mod 3 Z 2.6 2.8
av_6K_CKD_0603 0603 3390 Standard Mod 3 Z 2.6 2.8
Page 1 of 1
Total: 4 Filtered: 4 Displayed: 4
Create Paths

Figure 29-13 Select source volume

8. In the next panel, select the Storage Complex and Storage Unit for the LSS with the target volumes. Then, select the target volume for the first source volume. When you are finished, click **Next** as shown in Figure 29-14. To expand your choices, you must select the small blue boxes.

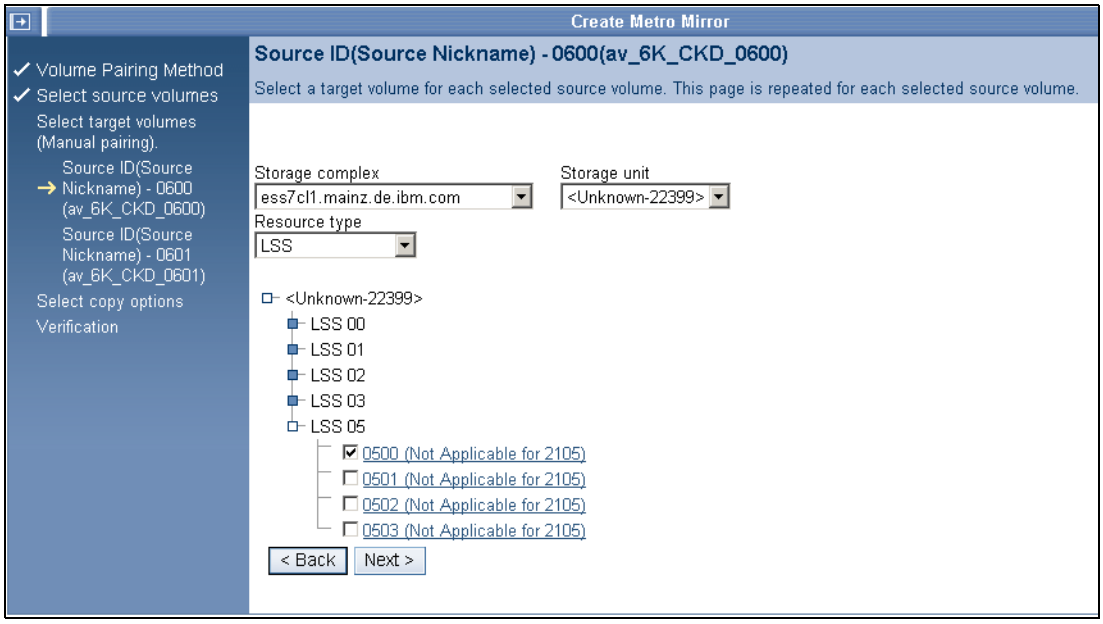

Figure 29-14 First Metro Mirror target volume

9. Next, select the target volume for the second source volume as shown in Figure 29-15 on page 449. To expand your choices, you must select the small blue boxes.

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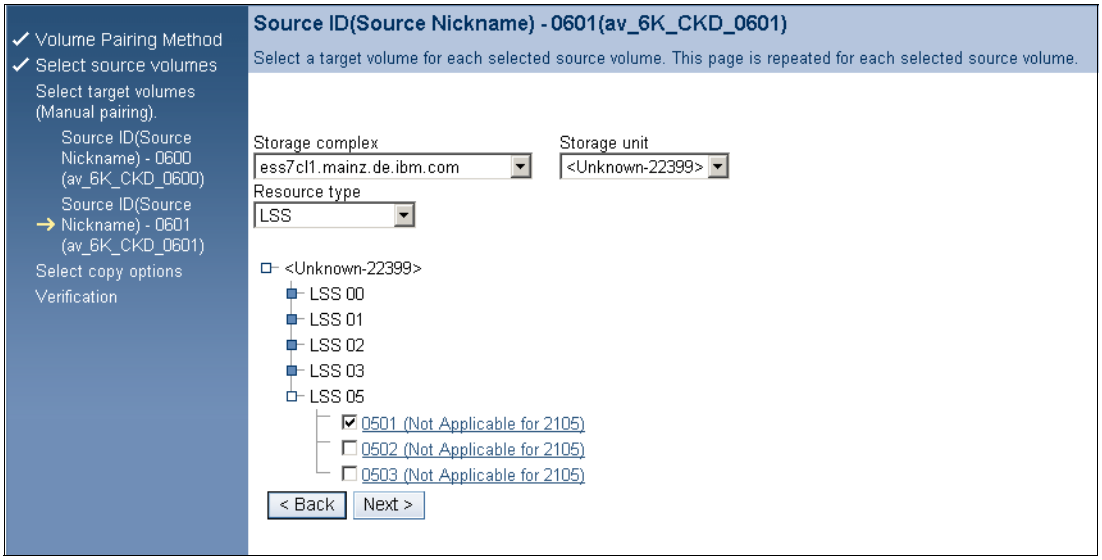

Figure 29-15 Second Metro Mirror target volume

10. In the next panel, you can specify various copy options as shown in Figure 29-16. In this example, we selected **Metro Mirror** under Define relationship type and **Perform initial copy**. If you wished to instead use Global Copy, this is where you would select it.

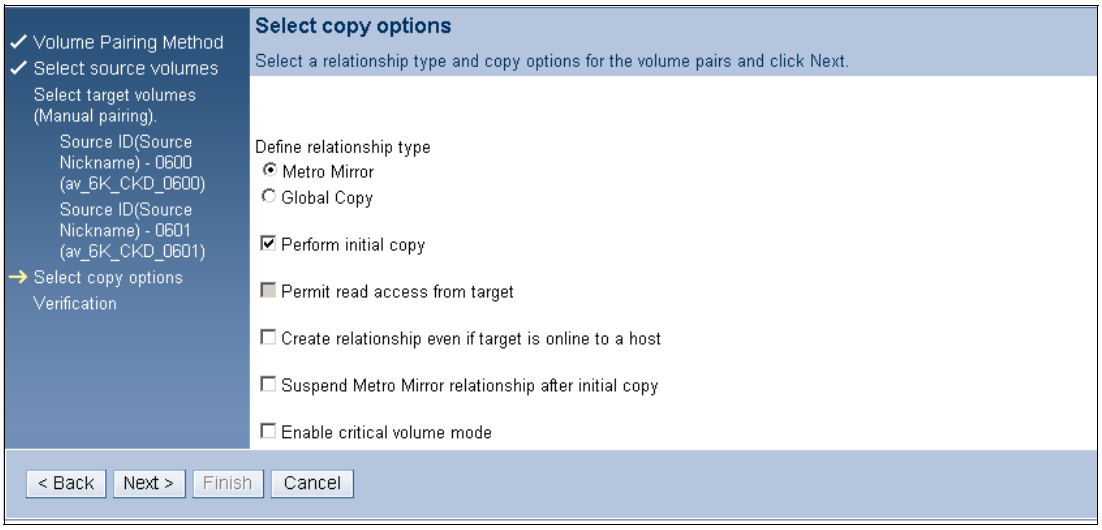
Volume Pairing Method
Select source volumes
Select target volumes (Manual pairing).
Source ID(Source Nickname) - 0600 (av_6K_CKD_0600)
Source ID(Source Nickname) - 0601 (av_6K_CKD_0601)
Select copy options
Verification
Select copy options
Select a relationship type and copy options for the volume pairs and click Next.
Define relationship type
Metro Mirror
Global Copy
Perform initial copy
Permit read access from target
Create relationship even if target is online to a host
Suspend Metro Mirror relationship after initial copy
Enable critical volume mode
< Back
Next >
Finish
Cancel

Figure 29-16 Copy options

11. The Verify panel opens. Verify the information that you entered, and if everything is correct, click **Finish** to establish the Metro Mirror volume pairs. Figure 29-17 on page 450 shows the Metro Mirror pairs for LSS 06 that we established. To manage the established pairs (for example, suspend pair) you can select the volume pair you want to manage and then select from the appropriate action that you want to perform from the menu.

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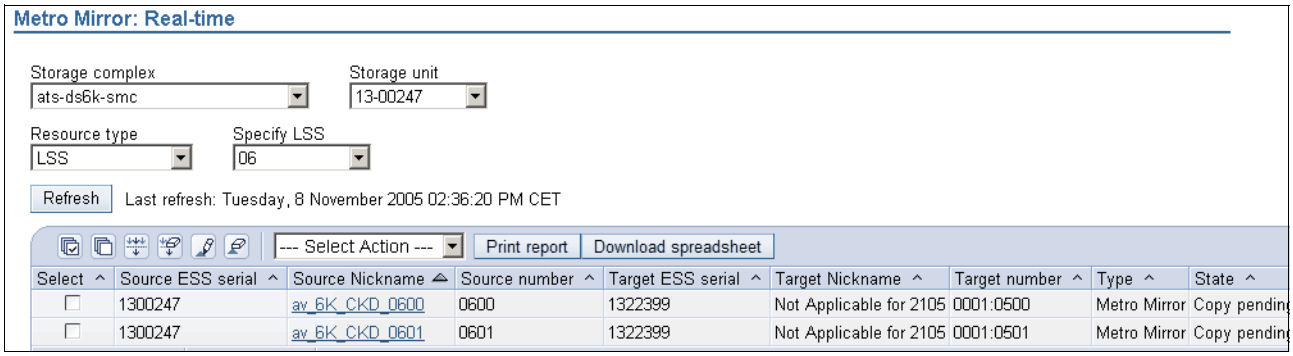

Figure 29-17 Managing Metro Mirror pairs

29.4.2 Managing Metro Mirror pairs with the DS CLI

In this example, we show how you can establish Metro Mirror volume pairs between a DS6000 and an ESS 800 with the DS CLI. We created two Metro Mirror pairs. Volumes 0600 and 0601 from the DS6000 are the source volumes, and the target volumes on the ESS are 0500 and 0501.

Example 29-11, we created the pairs with the **mkpprc** command. We then listed them with the **lspprc** command and removed one pair with the **rmpprc** command.

Example 29-11 Creating Metro Mirror pairs using DS CLI

```
dscli> mkpprc -remotedev IBM.2105-22399 -type mmir -mode full 0600:0500 0601:0501
Date/Time: 9 November 2005 1:17:38 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0600:0500 successfully
created.
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0601:0501 successfully
created.
dscli> lspprc 0600-0601
Date/Time: 9 November 2005 1:17:56 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
ID        State        Reason Type         SourceLSS Timeout (secs) Critical Mode First
=============================================================================================
0600:0500 Copy Pending -      Metro Mirror 06        unknown        Disabled      Invalid
0601:0501 Copy Pending -      Metro Mirror 06        unknown        Disabled      Invalid
dscli> rmpprc -remotedev IBM.2105-22399 0600:0500
Date/Time: 9 November 2005 1:19:05 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00160W rmpprc: Are you sure you want to delete the Remote Mirror and Copy volume pair
relationship 0600:0500:? [y/n] y
CMUC00155I rmpprc: Remote Mirror and Copy volume pair 0600:0500 relationship successfully
withdrawn.
```

We connected to the DS6000 SMC using DS CLI, so the ESS 800 is the remote device. To establish pairs where the ESS 800 is the source device, you must connect to the ESS 800 using the DS CLI. This will make the DS6000 the remote device.

Important: If you specify the wrong **-remotedev** or you are using a profile with a remote device specified that is different from the one you intended to work on, you might get an error message, CMUN03057, that says that you are specifying an invalid subsystem ID. This might be because you are specifying the wrong remote device serial number. If you have multiple potential remote devices, do not specify a remotedev in your DS CLI profile.

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29.4.3 Creating Metro Mirror pairs with TSO

In Example 29-12, we used the same paths that were created in 29.3.4, “Creating paths using TSO” on page 446. We established a volume pair with Metro Mirror from the DS6000 to the ESS 800.

Example 29-12 CESTPAIR command

```
//* ------------------------------------------------------------------- */
/*                                                                     */
/* ISSUE PPRC CESTPAIR TO ESTABLISH VOLUME PAIRS                       */
/*                                                                     */
/* ------------------------------------------------------------------- */
 CESTPAIR DEVN(X'202B') PRIM(X'1710' 00247 X'2B' X'00') -
          SEC(X'1070' 22399 X'2B' X'00') -
          OPTION(SYNC) MODE(COPY)
```

29.4.4 Managing Global Copy pairs with the DS CLI

In this example, we show how you can establish Global Copy volume pairs between a DS6000 and an ESS 800 with the DS CLI. We created a Global Copy pair. Volume 0603 from the DS6000 is the source volume, and the target volume on the ESS is 0503.

In Example 29-13, we created a pair with the **mkpprc** command. Then, we listed the pair with the **lspprc** command nand paused the pair with the **pausepprc** command.

Example 29-13 Using DS CLI to manage Global Copy

```
dscli> mkpprc -remotedev IBM.2105-22399 -type gcp 0603:0503
Date/Time: 9 November 2005 1:41:17 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0603:0503 successfully
created.
dscli> lspprc 0603
Date/Time: 9 November 2005 1:41:30 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
ID        State        Reason Type        SourceLSS Timeout (secs) Critical Mode First Pass
==========================================================================================
0603:0503 Copy Pending -      Global Copy 06        unknown        Disabled      False
dscli> pausepprc -remotedev IBM.2105-22399 0603:0503
Date/Time: 9 November 2005 1:41:55 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00157I pausepprc: Remote Mirror and Copy volume pair 0603:0503 relationship
successfully paused.
dscli> lspprc 0603
Date/Time: 9 November 2005 1:42:32 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
ID        State     Reason      Type        SourceLSS Timeout (secs) Critical Mode First
==========================================================================================
0603:0503 Suspended Host Source Global Copy 06        unknown        Disabled      False
```

29.5 Managing ESS 800 Global Mirror

The establishment of Global Mirror between a DS6000 and an ESS 800 is achieved using the same methods as explained in Chapter 26, “Global Mirror examples” on page 341.

29.5.1 Managing Global Mirror pairs using the DS CLI

In Example 29-14 on page 452, we established a Global Copy pair between volume 0500 on the ESS 800 and volume 0600 on the DS6000. Next, we created a FlashCopy on the remote

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device. Then, we created session 20 for LSS 05. Finally, we created a Global Mirror using session 20 and LSS 05.

Example 29-14 Establishing Global Mirror using DS CLI

```
dscli> mkpprc -remotedev IBM.1750-1300247 -type gcp 0500:0600
Date/Time: 9 November 2005 1:50:05 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0500:0600 successfully created.
dscli> mkremoteflash -dev IBM.1750-1300247 -conduit IBM.2105-22399/05 -nocp -record 0600:0601
Date/Time: 9 November 2005 1:50:40 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00173I mkremoteflash: Remote FlashCopy volume pair 0600:0601 successfully created. Use the
lsremoteflash command to determine copy completion.
dscli> mksession -lss 05 -volume 0500 20
Date/Time: 9 November 2005 1:52:26 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00145I mksession: Session 20 opened successfully.
dscli> lssession 05
Date/Time: 9 November 2005 1:52:41 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
LSS ID Session Status Volume VolumeStatus PrimaryStatus        SecondaryStatus   FirstPassComplete
==========================================================================================================
05     20      Normal 0500   Join Pending Primary Copy Pending Secondary Simplex True
dscli> mkgmir -lss 05 -session 20
Date/Time: 9 November 2005 1:52:59 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00162I mkgmir: Global Mirror for session 20 successfully started.
dscli> showgmir 05
Date/Time: 9 November 2005 1:53:07 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
ID                         IBM.2105-22399/05
Master Count               1
Master Session ID          0x20
Copy State                 Running
Fatal Reason               Not Fatal
CG Interval (seconds)      0
XDC Interval(milliseconds) 50
CG Drain Time (seconds)    30
Current Time               11/09/2005 01:42:25 EST
CG Time                    11/09/2005 01:42:25 EST
Successful CG Percentage   100
FlashCopy Sequence Number  -
Master ID                  IBM.2105-22399
Subordinate Count          0
Master/Subordinate Assoc   -
```

29.6 Managing ESS 800 FlashCopy

If there is a FlashCopy license for the ESS 800, it is possible to manage ESS FlashCopy with the DS CLI or DS GUI. The establishment of a FlashCopy pair on an ESS 800, using the DS GUI, is no different than establishing a DS6000 FlashCopy pair (see 9.6, “FlashCopy management using the DS SM” on page 87). The establishment of a FlashCopy pair on an ESS 800 using the DS CLI is also no different (see 9.4, “Local FlashCopy using the DS CLI” on page 73). In a situation where the ESS 800 is in a PPRC relationship, it is also possible to create remote FlashCopies using the **mkremoteflash** command. In each case, creating, changing, and removing the FlashCopy is done using the same commands.

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29.6.1 Creating an ESS 800 FlashCopy with the DS GUI

The steps to create an ESS 800 FlashCopy using the DS GUI are:

1. Click **Real-time manager**.
2. Click **Copy Services**.
3. Click **FlashCopy**.
4. From the Storage Complex menu, choose the ESS 800 Copy Services Domain.
5. From the Storage Units menu, select the ESS that you wish to perform the FlashCopy on
6. Make selections from the Resource type and Specify LSS pull-downs.
7. From the Select Action menu, select **Create**, as shown in Figure 29-18.

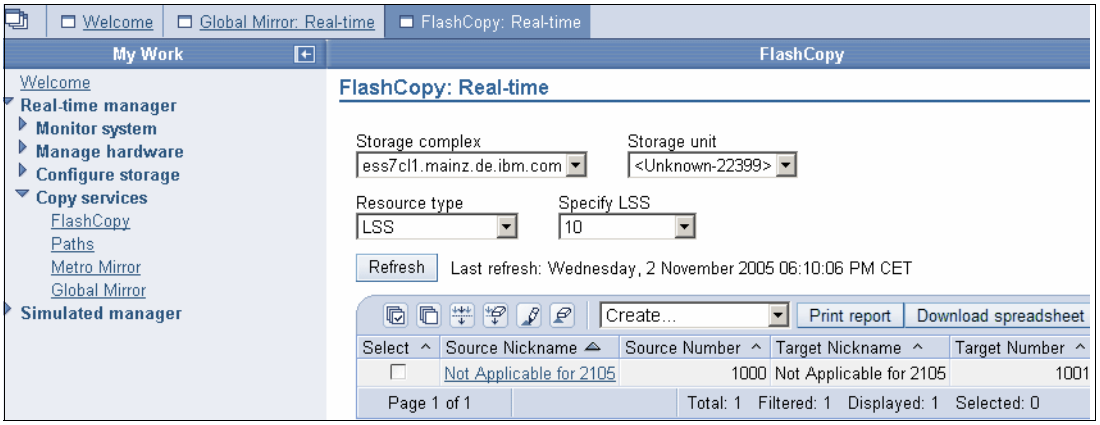

Figure 29-18 Creating ESS 800 FlashCopy using DS GUI

8. Select either **A single source with a single target** or **A single source with multiple targets** and click **Next**.
9. Select the source volumes as shown in Figure 29-19. Note that some of the columns have *Not Applicable for 2105* in them. This is normal.

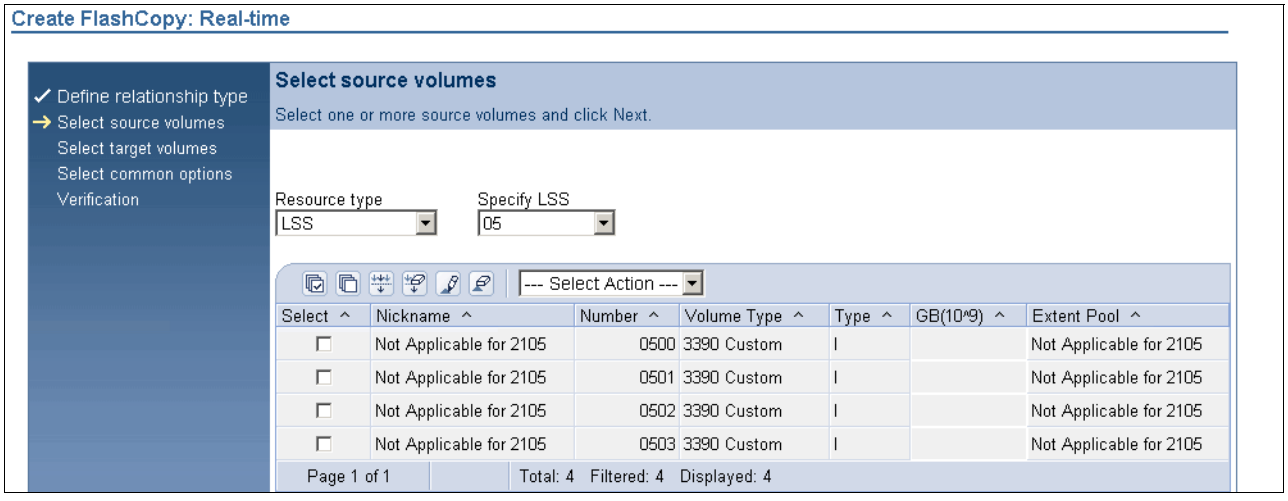

Figure 29-19 Selecting ESS 800 source volumes for FlashCopy

10. Select the target volumes and click **Next**.
11. Select the options that you plan to use and click **Next**.

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12. The verification panel opens. Review your selections and click **Finish**.

29.6.2 Creating an ESS 800 FlashCopy with the DS CLI

You must start the DS CLI and connect to the ESS 800. Then issue DS CLI commands as usual. An example is shown in Example 29-15.

Example 29-15 Using DS CLI to create an ESS 800 FlashCopy

```
dscli> mkflash -nocp -record -persist 0500:0501
Date/Time: 2 November 2005 20:04:33 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00137I mkflash: FlashCopy pair 0500:0501 successfully created.
dscli> lsflash 0500
Date/Time: 2 November 2005 20:04:37 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
ID        SrcLSS SequenceNum Timeout ActiveCopy Recording Persistent Revertible SourceWrite TargetWrite
==========================================================================================================
0500:0501 05     0           45      Disabled   Enabled   Enabled    Disabled   Enabled     Enabled
dscli> rmflash 0500:0501
Date/Time: 2 November 2005 20:04:54 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00144W rmflash: Are you sure you want to remove the FlashCopy pair 0500:0501:? [y/n]:y
CMUC00140I rmflash: FlashCopy pair 0500:0501 successfully removed.
```

29.6.3 Creating a remote FlashCopy on an ESS 800 with the DS CLI

You can use the DS CLI to create a remote FlashCopy on an ESS 800 where the source PPRC device is a DS6000. In Example 29-16, we connected to a DS6000. We created a Metro Mirror pair from volume 0600 on the DS6000 to volume 0500 on the ESS 800. We then created a remote FlashCopy on the ESS 800 between ESS 800 volumes 0500 and 0501, using a conduit LSS to send the command. We then removed the remote FlashCopy.

Example 29-16 Creating a remote FlashCopy where the ESS 800 is the remote target

```
dscli> mkpprc -remotedev IBM.2105-22399 -type mmir 0600:0500
Date/Time: 3 November 2005 3:59:22 IBM DSCLI Version: 5.1.0.204 DS: IBM.1750-1300247
CMUC00153I mkpprc: Remote Mirror and Copy volume pair relationship 0600:0500 successfully created.
dscli> mkremoteflash -dev IBM.2105-22399 -conduit IBM.1750-1300247/18 -persist -nocp 0500:0501
Date/Time: 3 November 2005 4:00:11 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00173I mkremoteflash: Remote FlashCopy volume pair 0500:0501 successfully created. Use the
lsremoteflash command to determine copy completion.
dscli> lsremoteflash -dev IBM.2105-22399 -conduit IBM.1750-1300247/18 0500:0501
Date/Time: 3 November 2005 4:00:24 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
ID        SrcLSS SequenceNum ActiveCopy Recording Persistent Revertible SourceWriteEnabled
==========================================================================================
0500:0501 05     0           Disabled   Disabled  Enabled    Disabled   Enabled
dscli> rmremoteflash -dev IBM.2105-22399 -conduit IBM.1750-1300247/18 0500:0501
Date/Time: 3 November 2005 4:01:36 IBM DSCLI Version: 5.1.0.204 DS: IBM.2105-22399
CMUC00179I rmremoteflash: Are you sure you want to remove the remote FlashCopy pair {0}? [y/n]:y
CMUC00180I rmremoteflash: Removal of the remote FlashCopy volume pair 0500:0501 has been initiated
successfully. Use the lsremoteflash command to determine when the relationship is deleted.
```

You can also reverse the scenario. using the ESS 800 as the source machine in a PPRC pair and then creating the remote FlashCopy on the DS6000.

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Note: Commands that work with remote FlashCopies use the **-dev** parameter to define the machine on which the FlashCopy is to be performed. Other commands, such as **mkpprc** commands, refer to this device as the remote device, using **-remotedev**. However, because a Flashcopy must be sent to the remote site and then performed locally there, the use of the **-dev** parameter to refer to the remote machine is correct.

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30

IIBM TotalStorage Rapid Data Recovery

IBM TotalStorage Rapid Data Recovery is a service offering solution from IBM Global Services based on enterprise Remote Copy Management Facility (eRCMF).

eRCMF is a standalone tool that provides a management layer for ESS800, DS8000, and DS6000 Copy Services in two-site or three-site topologies. It is a common management tool for both z/OS and open system environments. The Copy Services functions managed by eRCMF are Metro Mirror, Global Copy, Global Mirror, and Metro/Global Copy. At each site, a FlashCopy of the local volumes can also be managed.

This solution simplifies the process of repairing inconsistent Remote Copy pairs after an error with the copy process. eRCMF assists the user in automating the Remote Copy and FlashCopy processes.

Note: Because of its complex implementation, IBM Global Services (IGS) will work with your IT department to install and configure the solution to match your unique business environment. The storage servers, servers, and WebSphere software have to be ordered through the normal process. IGS provides eRCMF software and experts that support the implementation, education, and skill transfer for this solution.

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30.1 Introduction

eRCMF is a scalable and flexible solution that protects business data and maintains consistent data. It can be used to manage copy relationships for:

- Planned outages such as hardware and software upgrades, or disaster practice
- Unplanned outages such as an actual disaster

The solution provides basic commands through the FO/FB Session Manager Proxy, which utilizes the ESS Open API functions to accomplish either a planned or unplanned FO/FB sequence. eRCMF commands can be incorporated in any user scripts or utilities that may further link users' overall data center operations. However, the users are responsible for creation, maintenance and any liabilities associated with such scripts or utilities. Therefore, eRCMF offers a simple way to implement Remote Copy disaster recovery procedures via command line. eRCMF applies the commands to a set of configuration files that describe the disk subsystem configuration (paths and sets of volumes).

The solution does not depend on the operating system because no client installation is required.

30.1.1 Solution highlights

The eRCMF solution highlights and benefits are summarized in the following list. It:

- Provides automation capability.
- Simplifies disaster recovery operations.
- Improves protection of critical business data, guaranteeing data consistency and ensuring restart capabilities.
- Avoids human errors.
- Reduces risk of downtime.
- Lets you stay competitive, maintaining market readiness by managing risk more efficiently.
- Enables test and practice of disaster recovery setup regularly.
- Reduces testing risk.
- Provides a central, scalable, flexible enterprise class solution that protects your business.
- Simplifies the configuration:
  - Offers a simple configuration description.
  - Provides tools to verify the configuration.
- Simplifies the utilization with simple commands to fix problems.
- Needs no predefined Copy Services tasks.

30.2 Overview

In a Business Continuity solution based on disk remote mirroring, we want to restart a database application following an outage without having to restore the database. This process has to be consistent, repeatable, and fast: measurable in minutes.

A Database Recovery, where you have to restore the last set of Image Copy tapes and apply the log changes to bring the database up to the point of failure, is a process that can be measured in hours or even days. And this is what you want to avoid in a Tier 4 or higher

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solution. However, in a real disaster (fire, explosion, or earthquake) you can never expect the components of your complex to fail all at the same moment. Failures will be intermittent and gradual, and the disaster will occur over many seconds or even minutes. This is known as a *Rolling Disaster*. The architecture of a viable disk mirroring disaster recovery solution must avoid data corruption caused during a Rolling Disaster.

In any operating system, the sequence in which updates are being made is what maintains the integrity of the data. If that sequence is changed, data corruption will occur. The correct sequence must be maintained within a volume, across volumes, and across multiple storage devices. For instance, in Figure 30-1, we show the relationship between a database and its log, which demonstrates the requirement for maintaining I/O integrity. Data consistency across the storage enterprise must be maintained to insure data integrity.

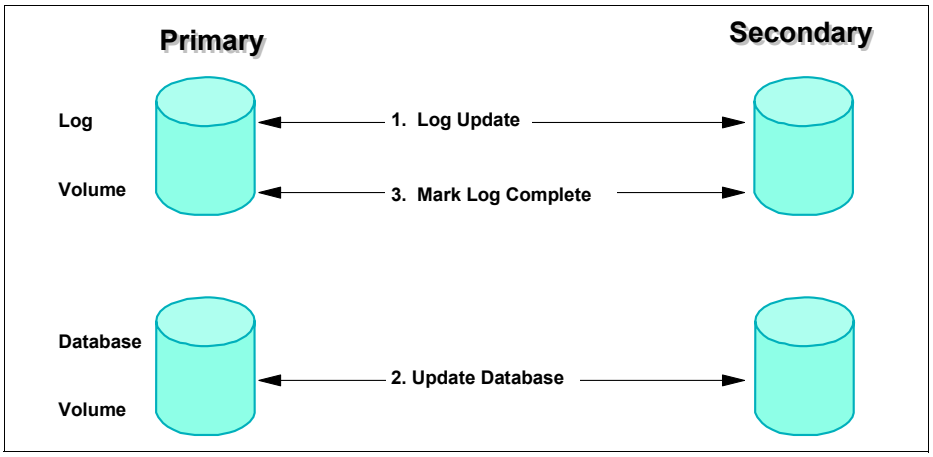

Figure 30-1 Sample update sequence in a database

The order of Dependent Writes across volumes must be maintained at remote locations. Failure to do so results in data corruption. The data consistency is lost.

In Figure 30-2 we illustrate this concept with an example. When a database update is about to take place, the change is first logged in the database log files at both the primary and secondary volumes (step 1). Assume the database data file is updated at the primary volume, but the update does not reach the remote volume that contains the mirrored data file. The primary location is not aware of the write failure to the secondary volume (step 2). The database update is marked complete in the log files at both the primary and remote locations (step 3). The result is that the secondary site log files say the update was done, but the updated data is not in the database at the secondary location. There is no way to know that the data was corrupted.

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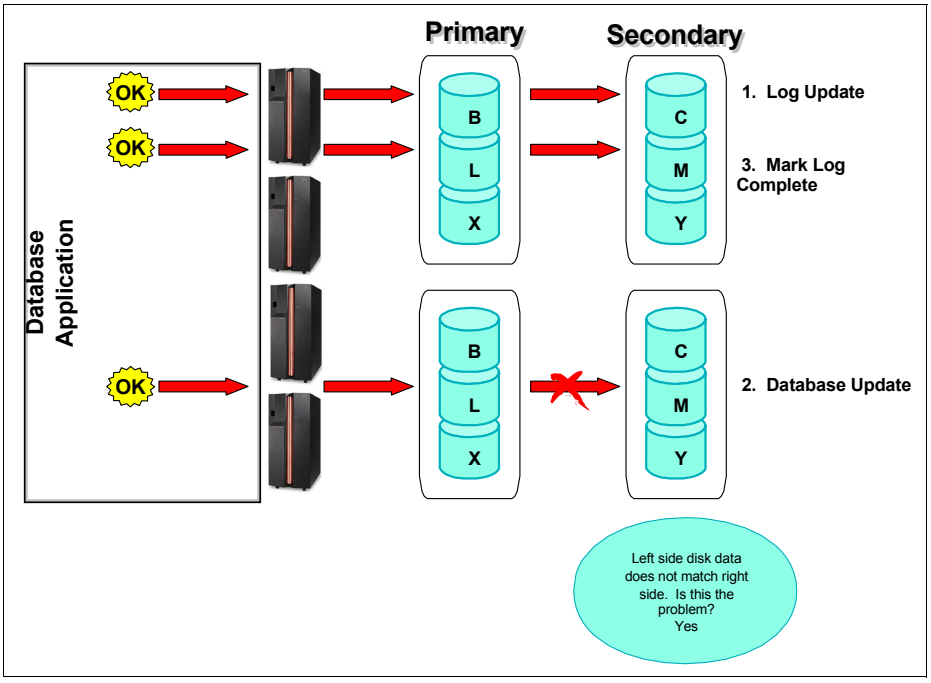

Figure 30-2 Sample Rolling Disaster

So, the issue is that the disk subsystem can't do it all and we must avoid this Rolling Disaster system problem.

For this reason, it is strongly recommended that, at a minimum, Consistency Groups be put in place for any mirroring solution. Consistency Groups are an implementation of technology that assists with the consistency of application data capable of dependent writes. To guarantee a fully consistent remote copy, multiple volumes require a Consistency Group functionality. ESS and DS6000/DS8000 Remote Copy microcode already has the Consistency Group function for both z/OS and open systems. SAN Volume Controller Metro Mirror's and DS4000 Remote Mirror's microcode has a Consistency Group function for open systems.

If any volume within a Consistency Group is unable to complete a write to its counterpart in the Remote Copy relationship, an Extended Long Busy (ELB) for mainframe environments or a SCSI Queue Full condition for open systems will be issued, preventing further writes to any of the volumes within the Consistency Group. This wait period is the perfect time to issue a freeze to all volumes involved to maintain consistency.

Figure 30-3 illustrates this mechanism. If a write is unable to complete, the storage subsystem will not back out incomplete transactions on its own. Instead the application will need to recognize that the transaction was incomplete and take the appropriate actions. Once the storage subsystem holds application I/O to the affected primary volumes, the write dependent mechanism of the application prevents the Remote Copy secondaries from becoming inconsistent.

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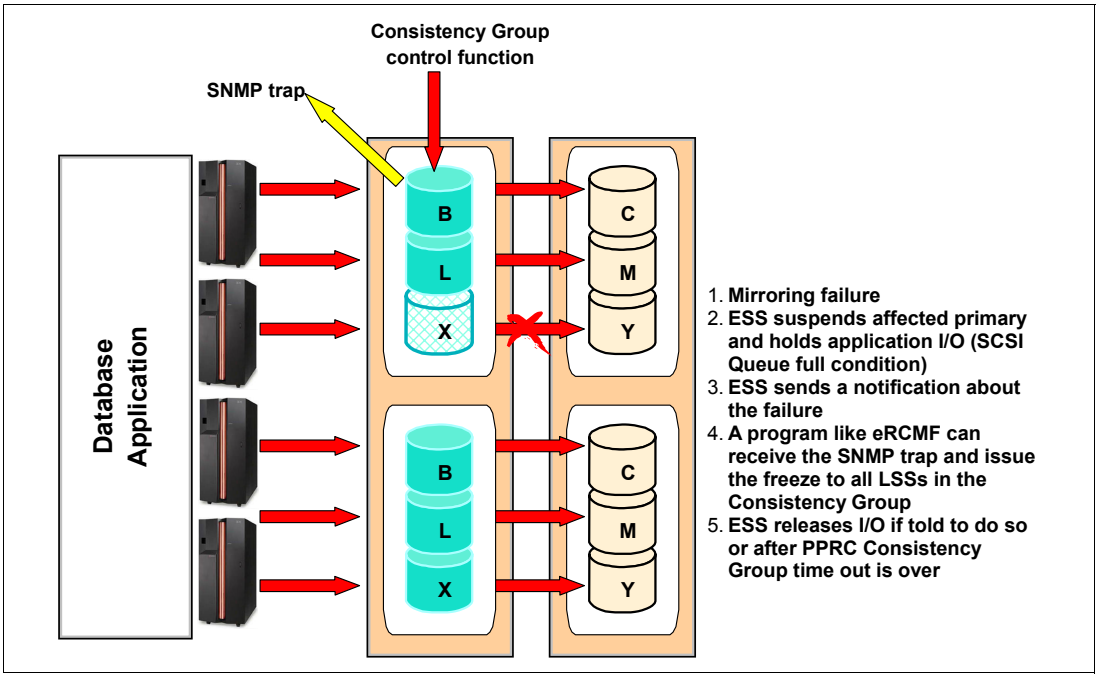

Figure 30-3 Dependent write protection of database integrity

Freeze is a command available through DS Command-Line Interface, DS Storage Manager (Graphical User Interface), the ESS API, ICKDSF or TSO, that stops the write activity on all of the active Remote Copy primary and secondary volumes of a given source and target Logical Subsystem (LSS) pair. This function ensures consistency between the primary and secondary volumes and can affect any LSS volumes that are in an active Remote Copy state between the frozen LSS pair: duplex, duplex pending SYNC or duplex pending XD states. It does not affect the suspended and simplex volumes that may be in the LSS.

The freeze operation has three effects:

1. The paths that connect the pair of LSSs being frozen are terminated.
2. The active volumes under the frozen LSS pair are suspended. This state transition, to suspended, is then communicated to the host with alert messages. These alert messages can be used by automation routines to trigger other recovery operations.
3. If the consistency group option was enabled at path definition time, then the ELB or SCSI Queue Full condition is instigated, so that the write activity to the primary LSS is temporarily queued. During this interval, other automated operations can be triggered; such as, freezing other application-related LSS pairs.

When using freeze through DS Storage Manager (Graphical User Interface) or ICKDSF, it will take effect on each LSS individually. This is useful for creating a point-in-time copy of the data, but because of slight delays between the issuing of each iteration of the freeze command it is unsuitable for preventing rolling disasters and should be done at periods of low utilization to ensure the of the secondary data can be used.

When Remote Copy is used in conjunction with automation, such as the Geographically Dispersed Parallel Sysplex (GDPS) or enterprise Remote Copy Management Facility (eRCMF) service offerings from IBM Global Services, a freeze command can be simultaneously issued to all LSSs within the configuration. This ensures globally consistent data across all LSSs in the secondary copy of data during a disaster.

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The goal of the TotalStorage Rapid Data Recovery for UNIX and Windows solution, based on the combination of ESS or DS6000 or DS8000 Copy Services with enterprise Remote Copy Management Facility (eRCMF), is to protect your data from being a mirror of a dying scenario.

Using Remote Copy Consistency Group, this solution freezes your environment at a known point instead of mirroring literally hundreds of time-offset failures in a short amount of time.

TotalStorage Rapid Data Recovery is based on enterprise Remote Copy Management Facility (eRCMF), an IBM Global Services offering. The current eRCMF Version 4 is designed as a 2-site or 3-site Disaster Recovery solution that runs on dedicated machines under WebSphere on AIX 5L™, which will be used as eRCMF servers.

Note: We strongly recommend that theRCMF servers be installed and run from different physical sites to ensure their backup capability.

eRCMF is a multi-site disaster recovery solution that manages data on volumes for Fixed Block (open systems hosts) and CKD (z/OS). The solution does not depend on the operating system because no client installation is required.

eRCMF is a Tier 4 and 6 solution, as shown in Figure 30-4.

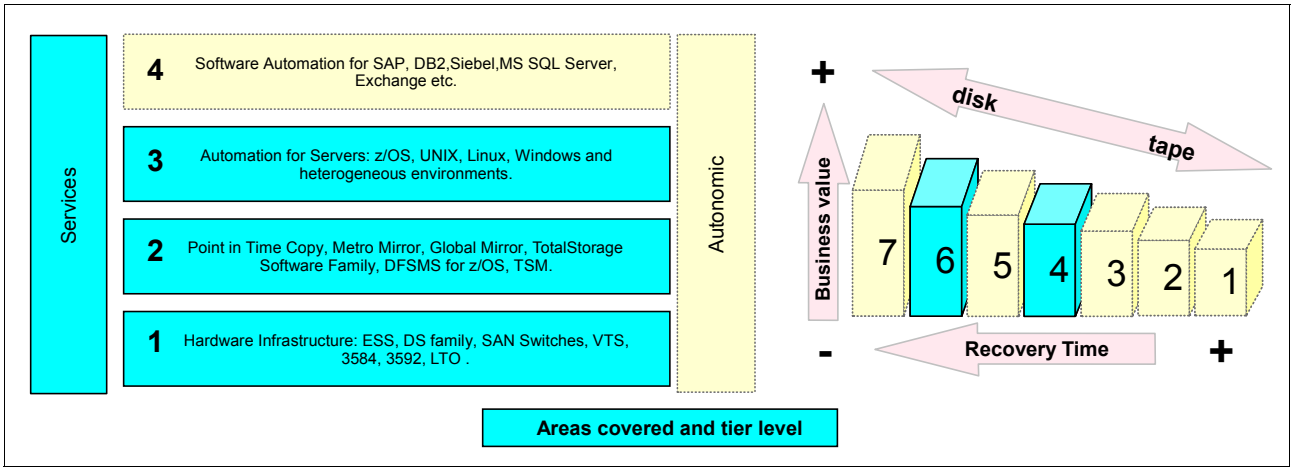

Figure 30-4 eRCMF protection tier

eRCMF is built on the technologies of Remote Copy, Java, WebSphere, and ESS Network Interface. You can mix these Storage Servers in this solution because ESS800, DS6000, and DS8000 share the same Copy Services functions. With DS8000 and DS6000, no Copy Services Server is required since each Storage Server can handle the Copy Services.

30.3 Architecture

eRCMF is a 2-site or 3-site solution. According to the diagrams in Figure 30-5 and Figure 30-6, one PCM is placed in each data center. The PCM in the primary data center runs the Master Process. This process is the interface into eRCMF. It handles all queries and commands for local processes through either a command-line or socket interface. It also manages commands and queries from the Backup Process.

A second PCM can be placed in the secondary (or backup) data center or, in a 3-site strategy, in the tertiary (or remote) data center. This PCM runs the Backup Process that maintains the state information of the configuration. This information is transferred to the

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second PCM in the form of logs from the Master Process. These logs are then used to update state information in case the Backup Process must take control of the configuration, as well as for documentation purposes if there is an alternate site failure.

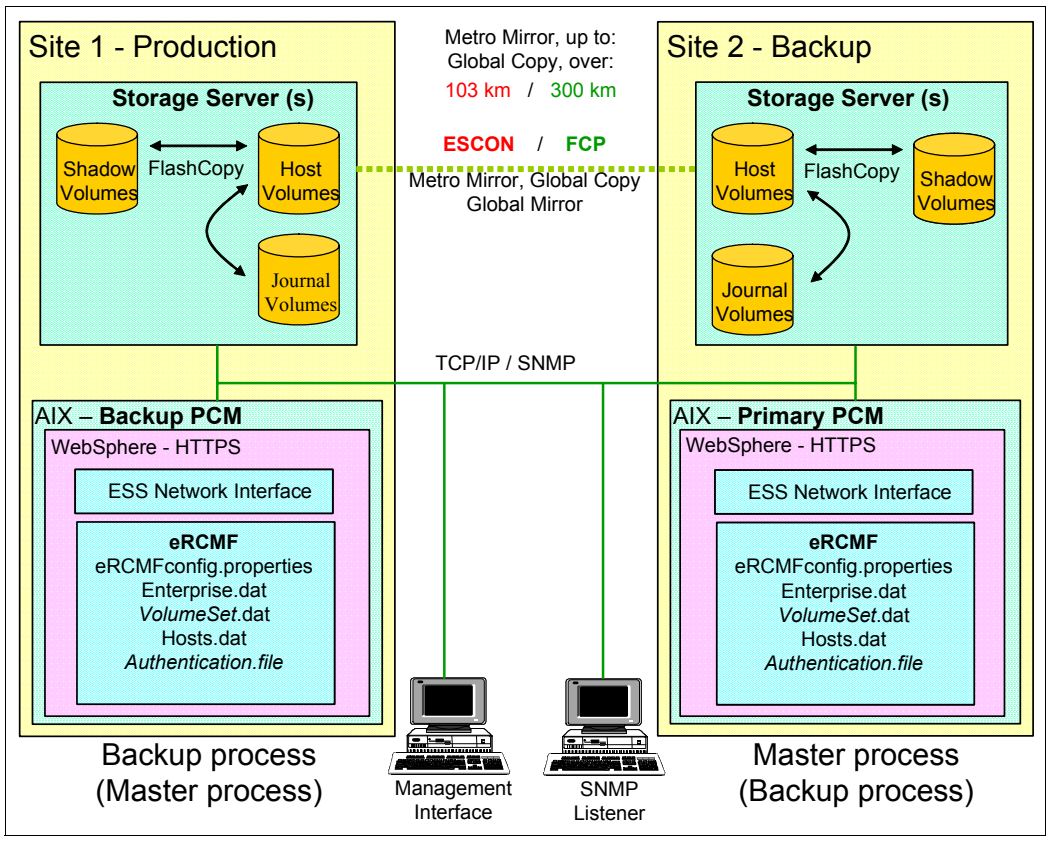

Figure 30-5 eRCMF Architecture: 2-site configuration

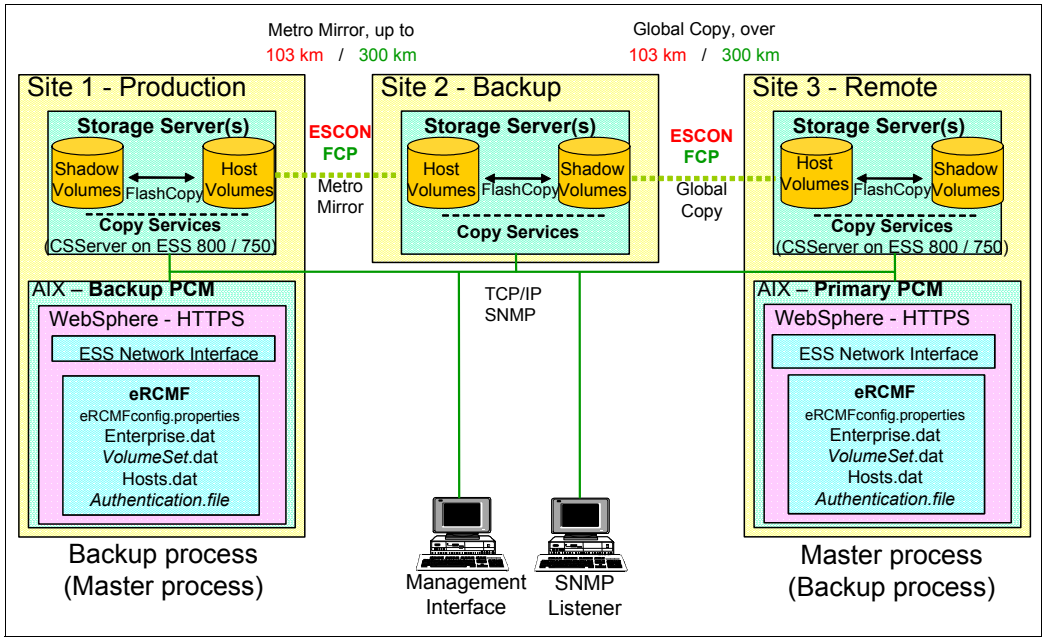

Figure 30-6 eRCMF Architecture: 3-site configuration

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The Master Process continuously monitors and manages the entire environment at two levels:

- The Enterprise level
- The VolumeSet level

The distinction between these levels is primarily the scope of actions performed at each level. The Enterprise level represents the entire monitored environment, which consists of two or three data processing locations containing storage managed by eRCMF. The VolumeSet level corresponds to a set of Storage Servers volumes which must be maintained in a consistent state and managed using the same type of copy operations. Some examples of a VolumeSet are the volumes used by a set of applications, the volumes allocated to a set of servers, or the members of a volume group.

Management at the Enterprise level affects the entire monitored environment. These actions typically affect every volume of every VolumeSet being managed by eRCMF. For example, the **freeze** command will cause suspension of Remote Copy pairs between the storage subsystems on multiple sites, as shown in Figure 30-7.

eRCMF adds a central control function to coordinate the Remote Copy Freeze function and stops transmission of data to the remote site consistently across single/multiple frames. When this function is centrally coordinated, data is consistent. Data consistency allows a very fast, very consistent restart time at the secondary site.

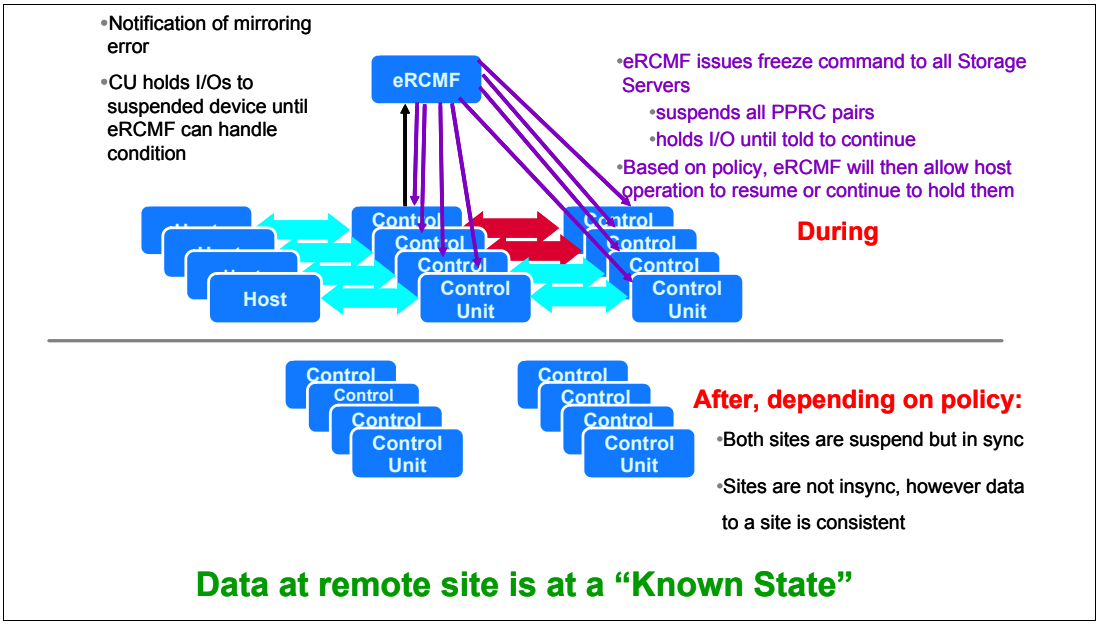
•Notification of mirroring error
•CU holds I/Os to suspended device until eRCMF can handle condition
eRCMF
•eRCMF issues freeze command to all Storage Servers
•suspends all PPRC pairs
•holds I/O until told to continue
•Based on policy, eRCMF will then allow host operation to resume or continue to hold them
During
Host
Control Unit
After, depending on policy:
•Both sites are suspend but in sync
•Sites are not insync, however data to a site is consistent
Data at remote site is at a "Known State"

Figure 30-7 eRCMF issues the freeze command in a disaster recovery scenario

There are two methods of maintaining consistent data:

- Metro Mirror
  - Use Synchronous Remote Copy to ensure that data is secure at the remote site before signaling the host that the write is complete.
  - During a disaster, you can combine the Consistency Group and Freeze functions in the Storage Server with software, such as eRCMF, to insure that all Remote Copy pairs of the Consistency Group are split in a manner that assures data consistency at the remote site.

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- Global Mirror
  - Storage Server periodically forms Consistency Groups. Testing has shown that given enough bandwidth, Storage Servers can form these groups on an average of every 3 to 5 seconds.
  - When recovering to the recovery copy, software such as eRCMF examines the states of the Global Mirror relationships and directs the Storage Server through the steps necessary to recover that data to the last committed consistent copy.

It should be noted that eRCMF neither performs an automated recovery nor an automated restart of systems in the remote site. Instead, eRCMF's **freeze** performs a controlled site *split* only. If a higher level of automation is required, eRCMF provides interfaces such as execution scripts or a command line interface, which can be utilized and customized. When this occurs, mirroring between Site 1 and Site 2 stops, ensuring the consistency of data. Further response by the automation is determined by policies that are selected based on individual business requirements:

- *Freeze and Go* quickly executes the **freeze** to ensure data consistency, but then immediately allows I/Os to continue. This allows processing to continue in the production data center while maintaining a consistent copy of the data in either the backup or remote data center. Meanwhile, the business is able to determine the cause of the event and whether it is a disaster. If a disaster has not occurred, production has not been impacted by an unnecessary site switch. If a disaster has occurred, then the data since the time of the site split may need to be recreated if recovering to a backup or a remote data center.
- *Freeze and Stop* quickly executes the **freeze** to ensure consistency but, rather than immediately allowing the I/Os to continue, causes the ESS to block all further I/Os until told otherwise. This ensures that no transactions, other than those in-flight at the time of the event, need to be recreated following a disaster. If the event turns out not to be a disaster, however, the production will be halted until the I/Os are freed.

30.4 Additional information

Further information can be found on the IBM Web site at:

`http://www-1.ibm.com/services/us/index.wss/so/its/a1000110`

For further information, you can refer to the following papers:

- *enterprise Remote Copy Management Facility eRCMF V4 Implementation Guide*
- *enterprise Remote Copy Management Facility eRCMF V4 User Guide*

You can find these papers at:

`http://www-1.ibm.com/support/docview.wss?uid=ssg1S7001074`

For more information, contact your IBM sales representative.

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31

IBM TotalStorage Productivity Center for Replication

The IBM TotalStorage Productivity Center for Replication is an automated solution to provide a management front end to Copy Services. This chapter describes IBM's strategic solution to manage disaster recovery solutions based on copy service functions in DS6000 and DS8000 storage servers. For details refer to the redbook and product manuals listed below.

In addition to the DS6000 and DS8000, the IBM TotalStorage Productivity Center for Replication or TPC for Replication can also help manage Copy Services for the SAN Volume Controller (SVC) as well as the ESS 800 when using FCP links for PPRC paths between ESS 800s or between ESS 800 and DS6000 and/or DS8000. This applies also to FlashCopy

For installation and configuration details, refer to *Replication Management with IBM TotalStorage Productivity Center,* SG24-7259

The following manuals are necessary when implementing and managing TPC for Replication configurations:

- *IBM TotalStorage Productivity Center for Replication User's Guide,* SC32-0103
- *IBM TotalStorage Productivity Center for Replication Installation and Configuration Guide,* SC32-0102
- *IBM TotalStorage Productivity Center for Replication Command-Line Interface User's Guide,* SC32-0104.

Note: The IBM TotalStorage Productivity Center for Replication is completely independent from TPC for Disk, Data and Fabric.

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31.1 IBM TotalStorage Productivity Center

The IBM TotalStorage Productivity Center or TPC is a suite of software products. It is designed to support customers in monitoring and managing their storage environments.

Design and development emphasis for TPC is on scalability and standards. The approach based on open standards allows TPC to manage any equipment or solution implementation which follow the same open standards.

Figure 31-1 shows a split set of products with three components based on former Tivoli products and a package with two components designed and developed to facilitate storage replication solutions.

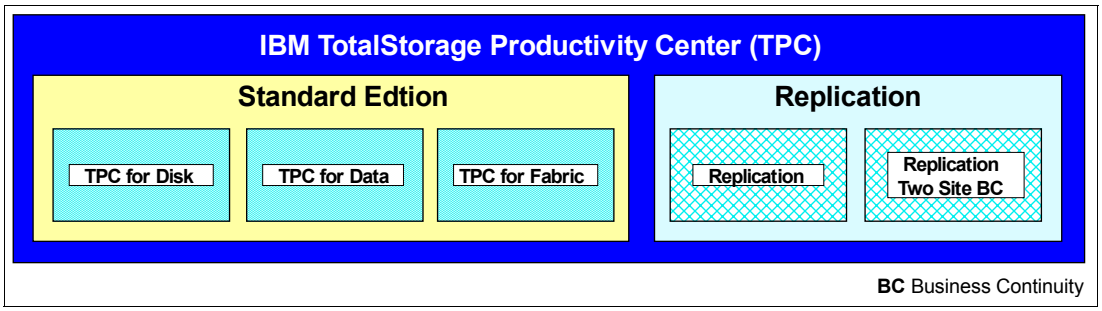

Figure 31-1 TPC software products suite

All three Tivoli products provide a single source and single management tool to cover the tasks of the storage manager or network manager in their daily business.

1. TPC for Disk is software based on open standard interfaces to query, gather and collect all available data necessary for performance management.
2. TPC for Data focus on data management and addresses aspects related to information life cycle management.
3. TPC for Fabric is a management tool to monitor and manage a SAN fabric.

TPC for Replication, as a member of the TPC product family, is a standalone package and does not build on anything related to the TPC Standard Edition.

It comes in two flavors as follows:

- TPC for Replication includes support for:
  - FlashCopy
  - Planned failover and restart (one direction) for MM and GM
- TPC for Replication Two Site Business Continuity (BC) includes support for:
  - FlashCopy
  - Planned and unplanned failover and failback for MM and GM
  - High availability (2 TPC Replication servers)

We now cover the basic structures and features of TPC for Replication and TPC for Replication Two Site BC.

This is solely related to Copy Services topics with the DS6000 and DS8000.

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31.2 Where we are coming from

Since the advent of copy services functions with IBM storage servers, a framework is required to handle and manage disk storage environments and the various combination of software, firmware, and hardware used for replication.

To ensure and guarantee data consistency at the remote or backup site, it is even more important to provide a framework around copy services functions that helps achieve that data consistency and ease of management.

Other aspects are automation and scalability. Early solution attempts turned out to have weaknesses that often would surface during actual implementation in real production environments. Tools offered on an “as-is” basis are not suitable for managing production environments. Other solutions are perfectly suited for certain host server platforms but cannot manage other server platforms.

This led to the design and implementation of a framework that is platform independent and provides the required production attributes such as scalability, stability, security and, as a standard product offering, the guarantee to be serviced and maintained. The concept furthermore has the potential for enhancements and can evolve over time and according to user requirements.

TPC for Replication does build on all previous experiences with storage management tools and framework proposals to organize all aspects of copy services for disaster recovery solutions. TPC for Replication also addresses the need for other solutions that involve copy services functions available with the DS6000 and DS8000, such as data or volume migration, data center movements, or other projects that require the copying or moving of data between *like* devices such as the DS6000, DS8000, and ESS 800.

31.3 What TPC for Replication provides

TPC for Replication is designed to help administrators manage copy services. This applies not only to the copy services provided by DS6000 and DS8000, but also to copy services provided by the ESS 800 and SAN Volume Controller (SVC).

In more detail, the functions provided by TPC for replication are:

- Manage Copy Services for the IBM System Storage DS6000 and DS8000.
- Extend support for ESS 800 to manage Copy Services.
- Provide disaster recovery support with Failover/Failback capability for the
  - ESS 800
  - DS6000
  - DS8000
- Monitor Copy Services performance.
- The optional high availability feature enables continuation of replication management even when one TPC for Replication server goes down.

The basic functions of TPC for Replication provide management of:

- FlashCopy
- Metro Mirror
- Global Mirror

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Note that TPC for Replication does not support Global Copy.

Figure 31-2 is a screen capture from the TPC for Replication GUI, showing the different session types, or Copy Services functions, supported.

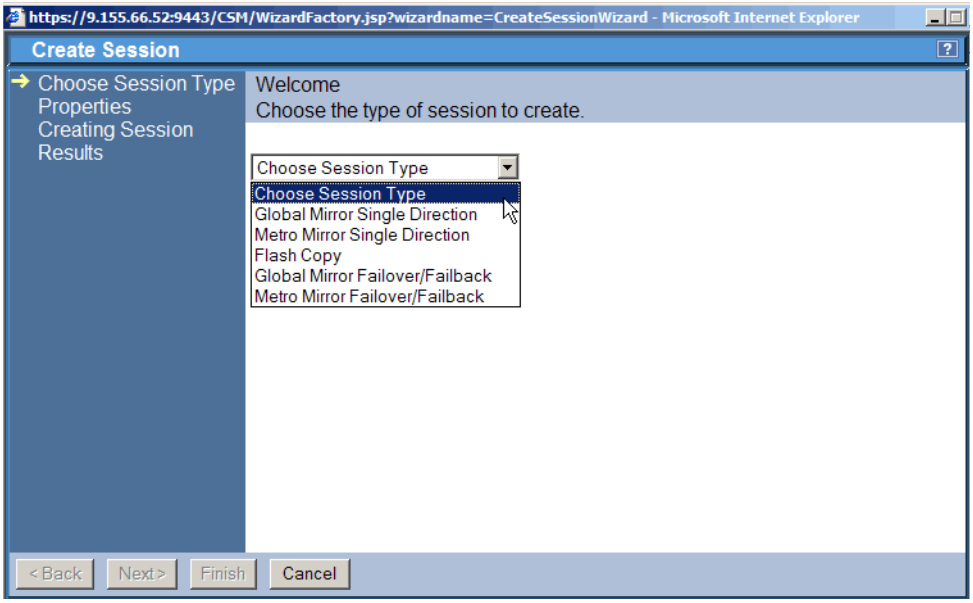

Figure 31-2 Management of Copy Services functions supported by TPC for Replication

TPC for Replication is designed to simplify management of Copy Services by:

- Automating administration and configuration of Copy Services functions with wizard-based session and copy set definitions.
- Providing simple operational control of Copy Services tasks, which includes starting, suspending, and resuming Copy Services tasks.
- Offering tools to monitor and manage Copy Services sessions.

Note that TPC for Replication also manages FlashCopy and Metro Mirror for IBM SAN Volume Controller, SVC.

31.4 Copy Services terminology

Although it is covered in a previous part of this book, we have included here, for convenience and to keep it in context with TPC for Replication, a brief review of Copy Services terminology.

31.4.1 FlashCopy

FlashCopy is a point-in-time copy of a source volume mapped to a target volume. It offers various options including the choice between a COPY option, for a background copy through physical I/O operations in the storage server back-end, or a NOCOPY option.

FlashCopy is available on the DS6000 and DS8000 as well as on the ESS 800. FlashCopy is also available on the DS4000 family and with SAN Volume Controller. Note, however, that the DS400 and SVC use different implementations of the FlashCopy function that are not compatible with the DS6000. DS8000, and ESS 800 FlashCopy.

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31.4.2 Metro Mirror

Metro Mirror (MM) is a synchronous data replication mechanism that was previously called Peer-to-Peer Remote copy or PPRC. I/O completion is signaled when the data is secured on both the local storage server and the remote storage server. Metro Mirror is popular for two site disaster recovery solutions.

Metro mirror is available in any combination between DS6000, DS8000, and ESS800. Synchronous data replication is also available on the DS4000 family and with the SVC, but again not directly compatible with Metro Mirror on the DS6000, DS8000, and ESS 800.

31.4.3 Global Copy

Global Copy (GC) is an asynchronous data replication mechanism that used to be called PPRC for eXtended Distance or PPRC-XD. Asynchronous in this context means that the data transmission between local and remote storage servers is separated from signaling the I/O completion. Note that GC does not guarantee that the arriving writes at the local site are applied to the remote site in the same sequence. Therefore, it does not provide data consistency. GC is suited for data migration over any distance.

Global Copy is possible in any combination between DS6000, DS8000, and ESS 800.

Restriction: TPC for Replication does *not* provide an interface to manage a Global Copy environment.

31.4.4 Global Mirror

Global Mirror (GM) is an asynchronous data replication over any distance. It is a combination of GC and FlashCopy complemented by unique firmware features. The firmware drives the copy operations in a fully autonomic fashion to guarantee consistent data at any time at the remote site. This holds also for the requirement to provide consistent data, at any time, which can be spread over more than a single storage server.

GM is also the base for a two-site disaster recovery solution involving any DS6000, DS8000, and/or ESS 800. The function as such is also possible between products of the DS4000 family and the SVC.

31.4.5 Failover/Failback terminology

There is often a misconception on what Failover/Failback commands do.

Figure 31-3 on page 472 illustrates the Failover/Failback two-step process. The process is as follows:

1. When the replication process between Primary P and Secondary S is suspended as a result of a planned or unplanned outage, you may want to access the S volumes immediately without any checking on the P volumes.

   The Failover command always points to the S volumes and turns the S volumes from SECONDARY state into a PRIMARY SUSPEND state, making the volumes immediately available to the application. This state change for the S volumes at the remote site happens without any communication or any checking of the P volumes at the local site. The P volumes at the local site keep the status they had before the Failover command was issued.

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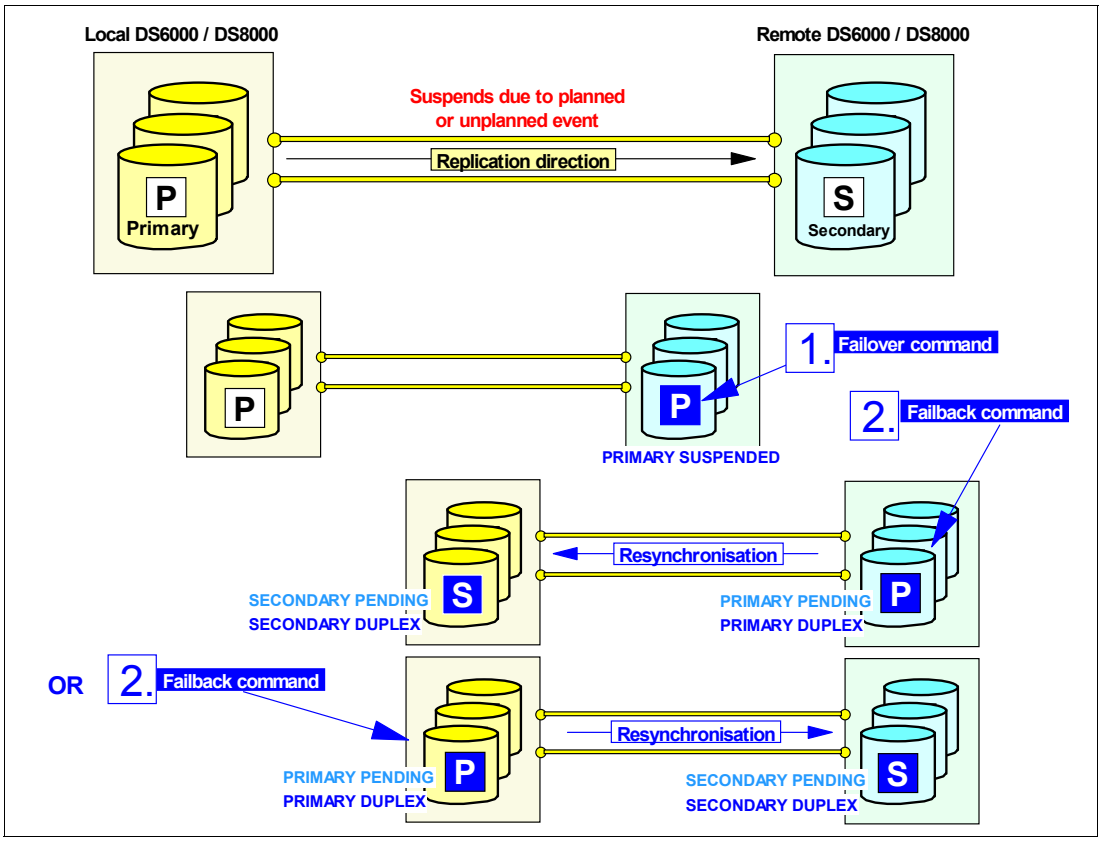

Figure 31-3 Failover/Failback terminology

2. Once the outage is over and you decide to resume replicating data, you have a choice as to whether to resynchronize from the remote site to the local site or vice versa. This depends on what is required after updating one of the two sites or even updating both sites after the suspend action.

   a. When you decide to resynchronize from the remote site to the local site, the Failback command is pointing to the remote volumes. You need a PPRC path from the remote to the local site before you can perform the corresponding commands. Doing this will resynchronize both sites with the level of data as it is at the remote site. Only the data that changed at the remote site, from the moment the replication was suspended and until the Failover happened, is replicated from remote to local volumes.

      Figure 31-3 assumes a Metro Mirror (MM) environment that puts the corresponding MM pair in PENDING state during resynchronization and once everything is replicated, the MM pair goes into DUPLEX state.

   b. If you want to resynchronize both sites with the data level at the local site, you issue the Failback command towards the volumes at the local site. This replicates the data changed since the suspend from the local to the remote site. Also, this resets the tracks that were potentially changed at the remote site after the Failover.

      Figure 31-3 assumes an MM environment that places the MM pair in PENDING state during the resynchronization phase. Once all changed data is replicated, the MM pair goes into DUPLEX state.

The option to resynchronize from either site is possible due to the availability of change bitmaps maintained by the DS6000 or DS8000 at both sites.

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31.5 TPC for Replication terminology

TPC for Replication manages and integrates not only the DS6000 and DS8000 but also the SAN Volume Controller. In search of a common terminology and to describe the functions for the different disk storage servers in a common way, new terms are introduced here that are different from those normally used in the context of Copy Services with the ESS 800, DS6000, and DS8000.

31.5.1 TPC for Replication Copy Set

A Copy Set in TPC for Replication is a set of volumes that have a copy of the same data. In PPRC terms this is, for example, a PPRC primary volume and a PPRC secondary volume.

Figure 31-4 shows three Metro Mirror Copy pairs. In TPC for Replication each pair is considered a Copy Set. A Copy Set here contains two volumes.

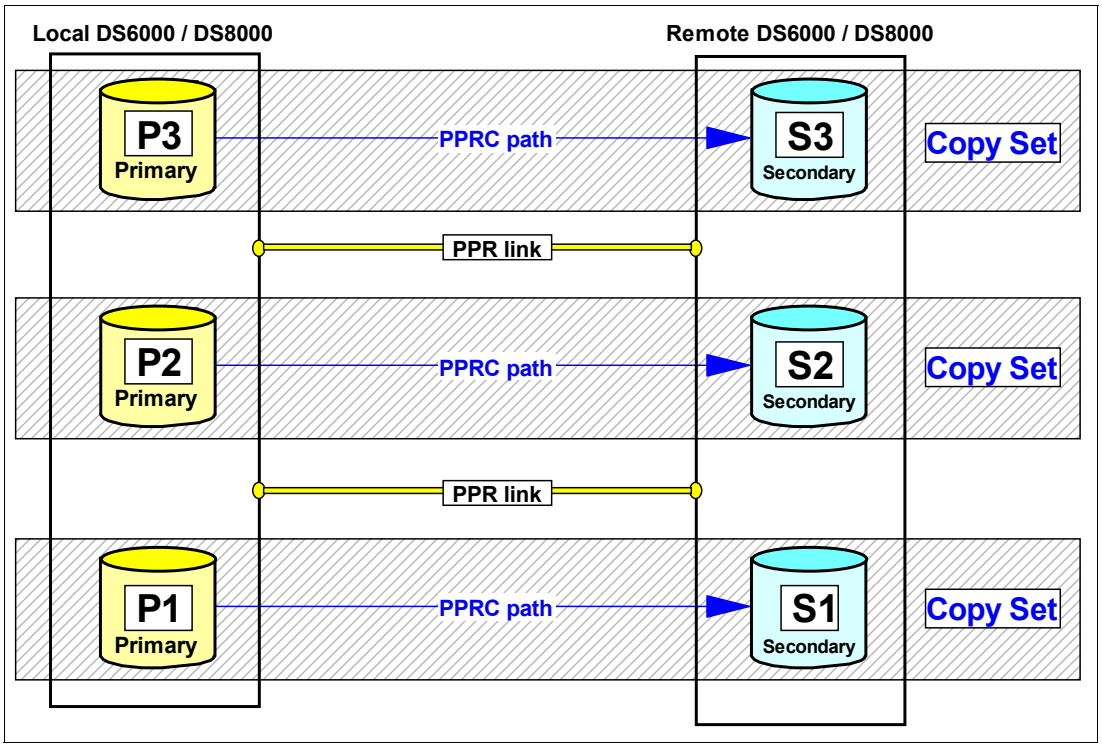

Figure 31-4 TPC for Replication - Metro Mirror Copy Sets

Figure 31-5 on page 474 represents two Copy Sets. In this illustration, each Copy Set contains three volumes, which indicates a Global Mirror configuration. Note that the third volume is a kind of journal volume and is the FlashCopy target volume for data consistency in a Global Mirror setup.

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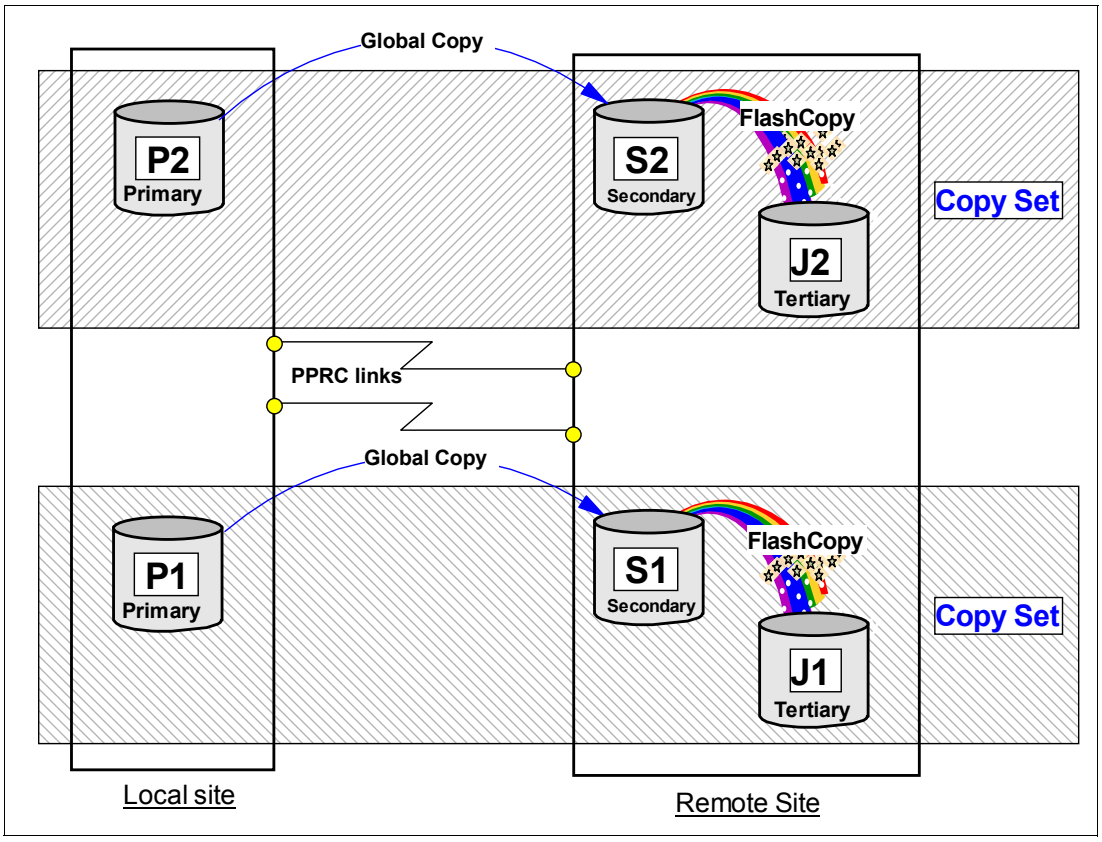

Figure 31-5 TPC for Replication - Global Mirror Copy Sets

31.5.2 TPC for Replication session

TPC for Replication uses a session concept that is similar to what Global Mirror for System z (XRC) uses.

A session is a logical concept that gathers multiple Copy Sets, representing a group of volumes with the requirement to provide consistent data within the scope of all involved volumes. Commands and processes performing against a session apply these actions to all Copy Sets within the session. Again, this is similar to a Global Mirror for System z (XRC) session.

Figure 31-6 on page 475 shows an example of two storage servers at the local site and two corresponding storage servers at the remote site. The example further assumes that a Metro Mirror relation is established to replicate data between both sites.

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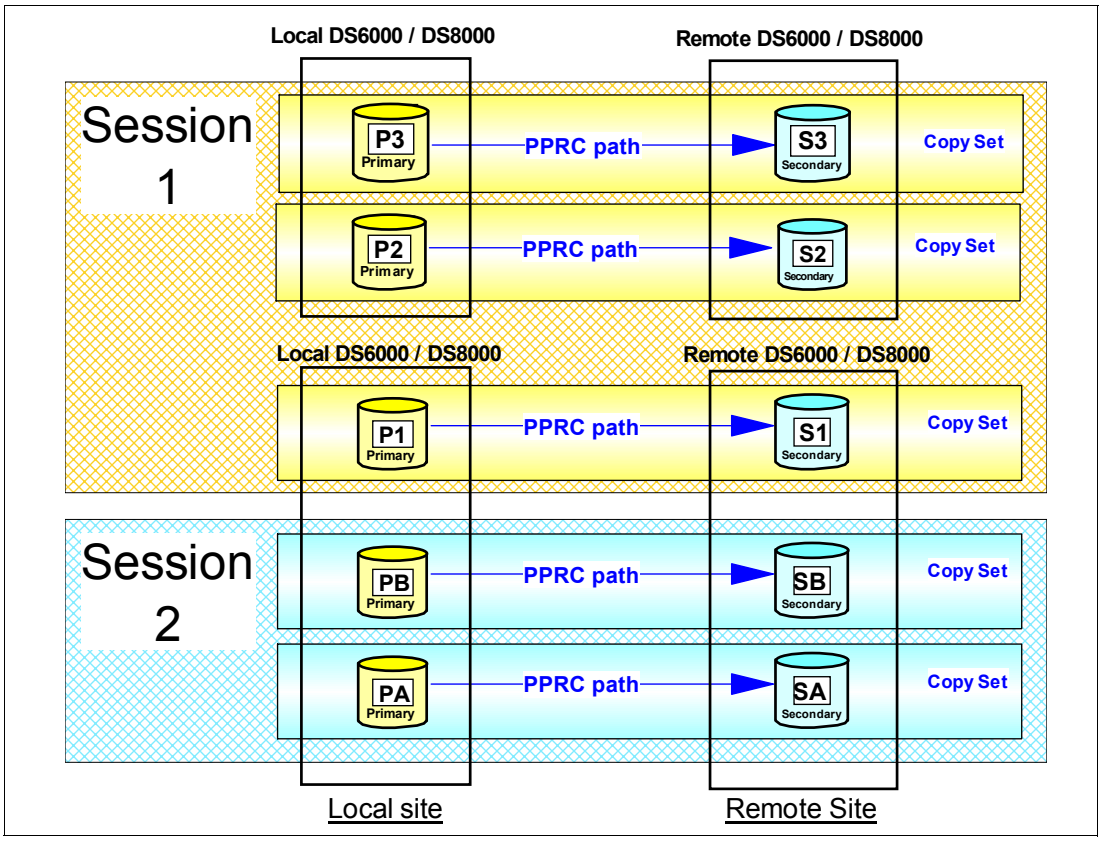

Figure 31-6 TPC for Replication - Session concept

Metro Mirror primary volume P1 in the second storage server and volumes P2 and P3 in the first storage server with their corresponding Metro Mirror secondary volumes are grouped together in a session, *session 1*. Such a session can contain Copy Sets that span storage server boundaries.

Metro Mirror primary volumes PA and PB with their counterparts at the remote site belong to a different session, *session 2*.

Note that all application-dependent Copy Sets must belong to the same session to guarantee successful management and to provide consistent data across all involved volumes within a session. In this context it is recommended to have application-dependent volume granularity within the scope of an LSS. Or, in other words, volumes or Copy Sets that require consistent data and can be subject to a freeze trigger ought to be grouped in one or more LSS and that LSS must not contain other Copy Sets. This is because the scope of the freeze function is at the LSS level and affects all volumes within that LSS.

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31.6 TPC for Replication session types

There are two TPC for Replication editions, which include different levels of Copy Services functions.

31.6.1 TPC for Replication Basic Edition

The Basic Edition also includes Metro Mirror and Global Mirror, besides FlashCopy. However, Metro Mirror and Global Mirror are only configured to replicate data in a unidirectional fashion.

FlashCopy

FlashCopy includes all functional flavors of FlashCopy. This includes FlashCopy with the following:

- Background copy or no background copy
- Convert no background copy to background copy
- Add persistent to a FlashCopy relationship
- Establish incremental FlashCopy to apply only changed data since a previous FlashCopy operation

Metro Mirror

Metro Mirror between a local site (site 1) and a remote site (site 2) in a unidirectional fashion. It also allows to switch the replication direction from site 2 to site 1. This may happen through Failover/Failback operations.

Global Mirror

Global Mirror implies three volumes for each Global Mirror Copy Set. Again this happens between a local site (site 1) and a distant site (site 2) in a unidirectional way. It is possible to reverse the replication direction but still only in a unidirectional fashion.

31.6.2 TPC for Replication Advanced Edition

The Advanced Edition has, in addition to the Basic Edition, the capability to replicate data in either direction or in a bidirectional fashion.

Metro Mirror

Metro Mirror may be established from site 1 to site 2 or vice versa or in both directions at the same time (bidirectional).

It also allows Failover/Failback operations for any Copy Set at any time.

Global Mirror

The Advanced Edition allows the Global Mirror to operate in either direction at the same time (bidirectional). It may also swap sites with Failover/Failback operations.

Global Mirror builds on three volumes per Copy Set. TPC for Replication makes it possible to also manage a configuration that only replicates data through Global Copy in the opposite direction from what Global Mirror did before.

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31.7 TPC for Replication session states

Again, a session contains a group of Copy Sets (that is, RMC (PPRC) volume pairs or FlashCopy pairs) that belong to a certain application. You may also consider it a collection of volumes that belong to a certain application or system with the requirement for consistency.

Such a session may be in one of the following states:

Defined
A session is defined and may already contain Copy Sets or have no Copy Sets assigned yet. However, a defined session is not yet started.

Preparing
The session started already and is in the process of initializing, which may be, for example, in case of a first full initial copy for a Metro Mirror. It may also just reinitialize, which, for example, may be the case for a resynchronization of a previously suspended Metro Mirror. Once the initialization is complete, the session state changes to *prepared*.

Prepared
All volumes within the concerned session completed the initialization process.

Suspending
This is a transition state caused by either a suspend command or any other suspend trigger, which may be an error in the storage subsystem or loss of connectivity between sites. Eventually the process to suspend Copy Sets ends and copying has stopped, which is indicated by a session state of *suspended*.

Suspended
Replicating data from site 1 to site 2 has stopped. Application writes to concerned volumes in site 1 can continue (FREEZE & GO). An additional recoverable flag indicates whether the data is consistent and recoverable.

Recovering
A session is about to recover.

TargetAvailable
The recover command has completed and the target volumes are write enabled and available for application I/Os. An additional recoverable flag indicates whether the data is consistent and recoverable.

Important: Do not manage Copy Service volume pairs that are already managed with TPC for Replication with some other software.

31.8 Volumes in a copy set

With TPC for Replication, the role of a volume within Copy Services has been renamed to be more generic and also to include other storage subsystems such as SVC.

A Copy Set contains the volumes that are part of a Copy Services relationship. Metro Mirror knows two volumes per Copy Set. Global Mirror requires three volumes per Copy Set. FlashCopy again consists of two volumes per Copy Set.

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Terminology is slightly different from what you may be used to. For example, Metro Mirror uses a primary or source volume at the sending site and a secondary or target volume at the receiving end. Such a pair is now called a Copy Set.

FlashCopy usually used to mention source and target volume to identify a FlashCopy pair—in contrast to RMC, which designates volumes in that pair as primary and secondary volumes. Again, such a FlashCopy volume pair is now a Copy Set.

Global Mirror involves three volumes per Copy Set. Global Mirror relies on Global Copy and FlashCopy. Therefore, we have a Global Copy primary volume and a Global Copy secondary volume. The Global Copy secondary volume has another role as FlashCopy source volume. The third volume is then the FlashCopy target volume. All three volumes are part of a Global Mirror Copy Set.

31.8.1 Host volume

A host volume is identical to what is called a primary or source volume in Copy Services. The host designation represents the volume functional role from an application point of view. It is usually connected to a host or server and receives read, write, and update application I/Os.

When a host volume becomes the target volume of a Copy Services function, it is usually no longer accessible from the application host. FlashCopy target volumes can be considered an exception.

31.8.2 Target volume

A target volume is what was also usually designated as a secondary t volume. It receives data from a host volume or another intermediate volume. It may also be an intermediate volume as in a Global Mirror Copy Set.

31.8.3 Journal volume

A journal volume is currently the FlashCopy target volume in a Global Mirror Copy Set. It is called a journal volume because it functions like a journal and holds the required data to reconstruct consistent data at the Global Mirror remote site. When a session needs to be recovered at the remote site, the journal volume is used to restore data to the last consistency point.

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31.9 TPC for Replication and scalability

From an architecture point of view there is no limit to the number of Copy Sets that may belong to a single session. The implementation approach of managing Copy Sets and sessions provides the scalability that very large installations require.

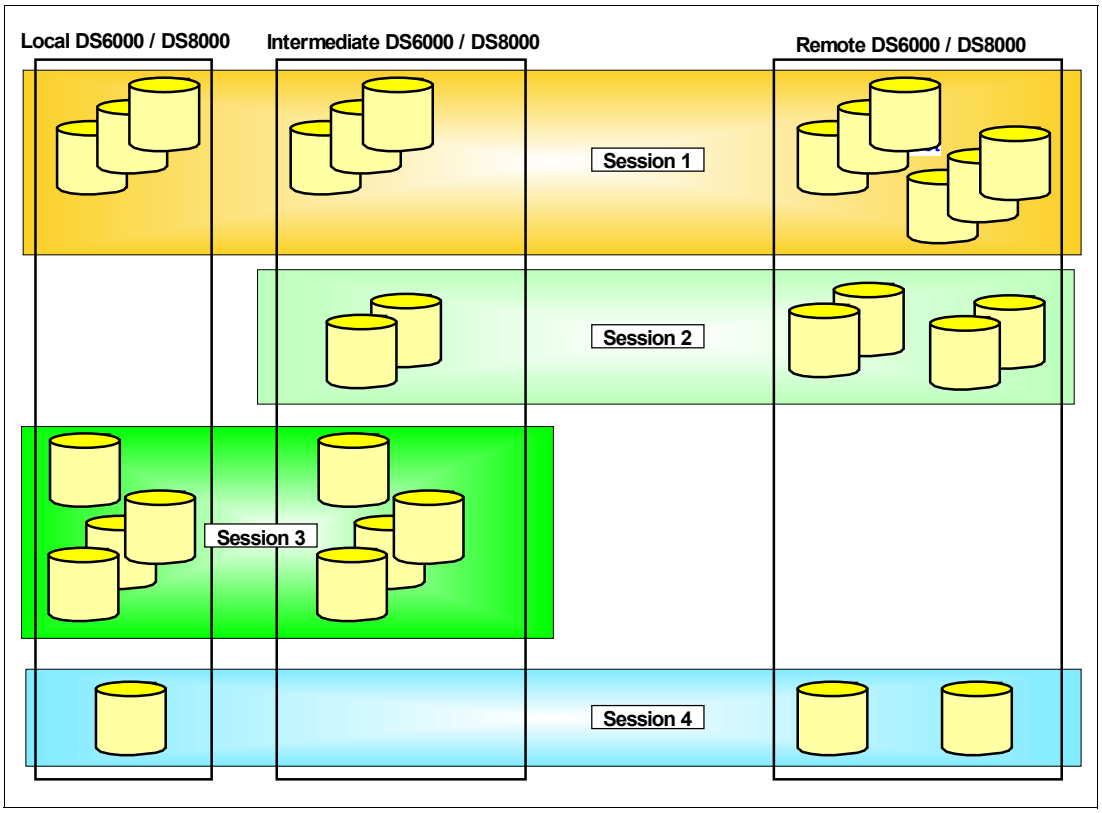

Figure 31-7 TPC for Replication - four sessions

There is also no limit to the number of sessions that TPC for Replication can manage.

Figure 31-7 shows four sessions managing different Copy Sets. The first session, *Session 1,* implies a Metro/Global Mirror configuration that is *not* supported (at the time of writing this redbook) by TPC for Replication.

The second session, *Session 2,* is a Global Mirror session between an intermediate site and a remote site with two Copy Sets.

The third session, *Session 3,* is a Metro Mirror configuration between the local and intermediate site.

The session at the bottom in Figure 31-7, *Session 4,* is a Global Mirror session between the local and remote sites.

31.10 TPC for Replication system and connectivity overview

TPC for Replication is an outboard approach. Its software runs on a dedicated server or, better, on two servers, for a high availability configuration.

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Figure 31-8 shows how the TPC for Replication server connects to the storage servers which are going to be managed by TPC for Replication server(s). It does not show the connectivity of the TPC for Replication server to the network through which the users connect with their browsers to the server itself.

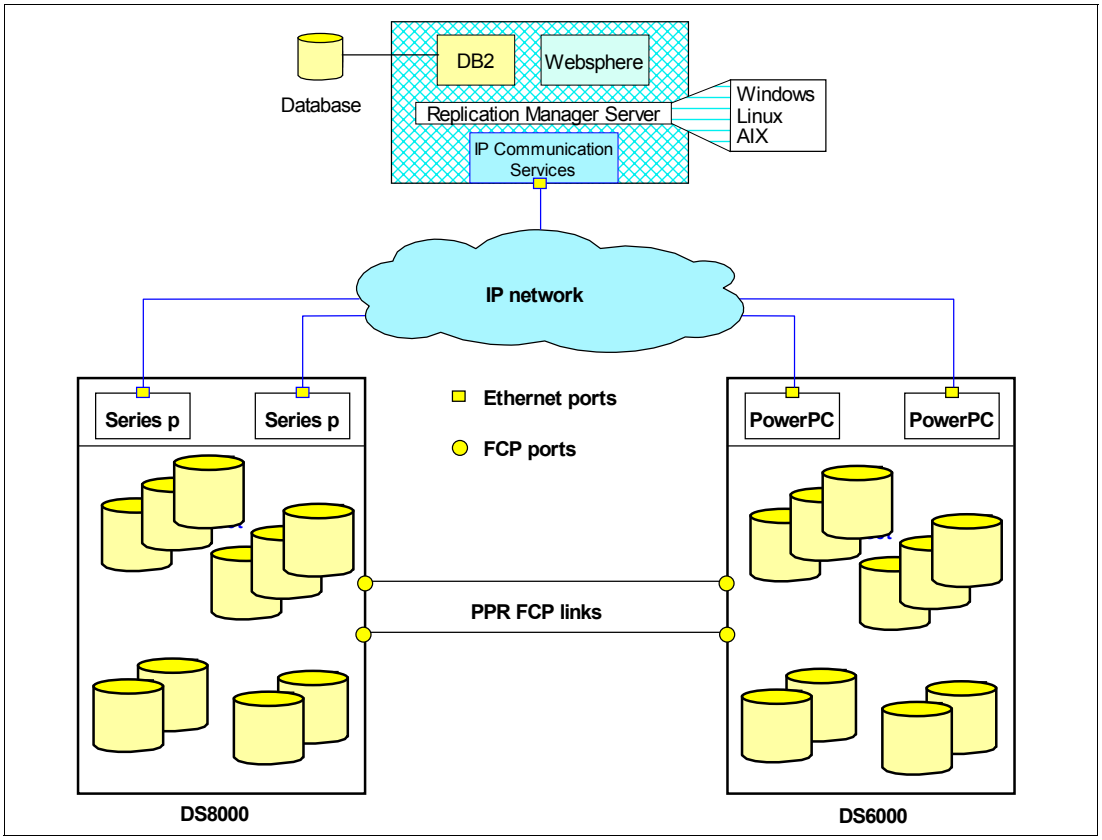

Figure 31-8 TPC for Replication system overview

The TPC for Replication server contains, besides the actual functional code, DB2 UDB and WebSphere® software.

IP communication services also contain an event listening capability to react on respective trap messages from the storage servers. This provides a handle to plan for particular events and provide preestablished scripts that are going to be triggered by a corresponding trap message. This also includes a capability to distinguish between the different storage servers that can be managed by the Replication Manager, such as DS6000, DS8000, ESS 800, and SVC. This approach has the potential to be enhanced as storage servers change over time without touching the functional code and the involved database.

Figure 31-9 on page 481 shows how the Replication Manager server connects to the DS6000 and DS8000.

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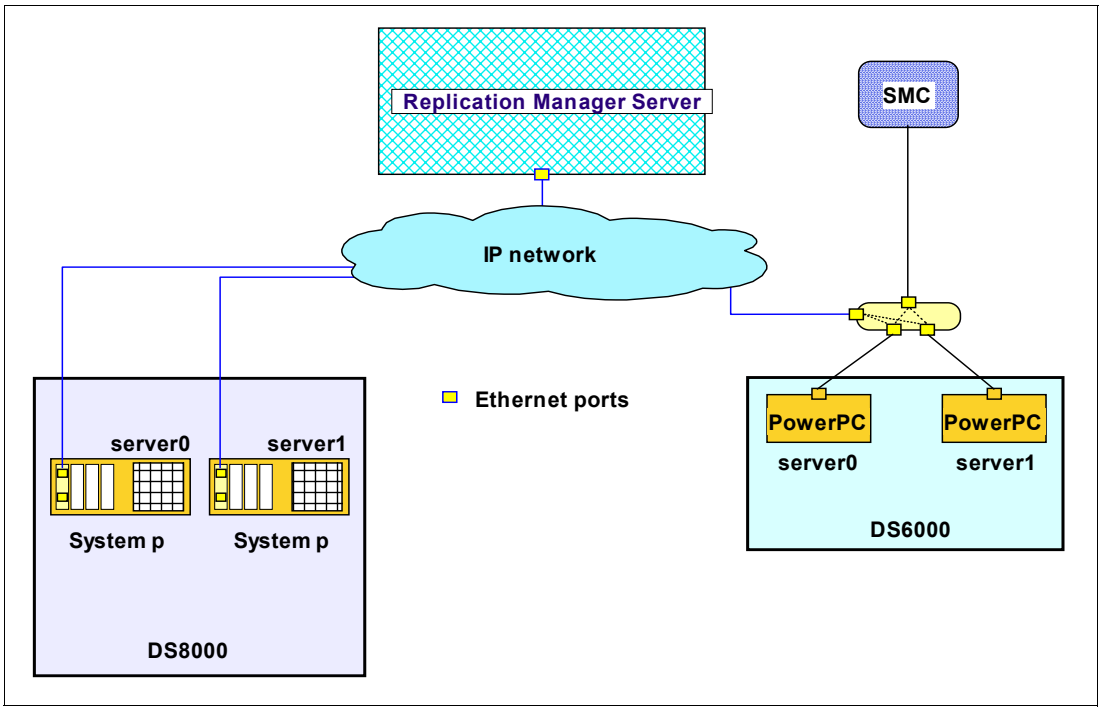

Figure 31-9 Replication Manager server connectivity to DS6000 and DS8000

The actual connectivity between the TPC for Replication server and the storage servers is based on Ethernet networks and connects to particular Ethernet ports in the System p™ in the DS8000. This particular Ethernet card is a new card and slides into the first slot of these four slots in the p570. Note that Figure 31-9 shows the DS8000 rear view because these slots are only accessible from the rear of the DS8000.

New DS8000 Ethernet card feature codes

This new Ethernet card is required for TPC for Replication and available for the following DS8000 models:

- 921, 922, 931, and 932 with feature code 1801 for the Ethernet adapter pair. Note that you always need a pair of cards because one Ethernet card installs in sever0 and a second card installs in server1
- 9A2 and 9B2 with feature code 1802 for the Ethernet adapter pair for the first LPAR.
- 9A2 and 9B2 with feature code 1803 for the Ethernet adapter pair for the second LPAR.

These features are chargeable and carry a minimum monthly maintenance charge.

DS8000 Ethernet card installation and configuration considerations

This new Ethernet card may come already installed or may be installed on site.

To configure the Ethernet ports, Release 2 microcode is required for the concerned DS8000. This is a code bundle that starts with 6.2.xxx.xx.

Port numbers on the first card are I9801 and I9802. This is the card that installs in server0. Port numbers on the second card are I9B01 and I9B02. This is the card that installs in server1. Note that only the first port on each card is currently used.

Communication through these ports uses static IP addresses. DHCP is not supported.

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You may configure these new ports either through the GUI or the DSCLI.

The GUI provides a new panel to configure the required IP addresses. This panel is in the GUI path of the *Storage Image*. Under Storage Image is a new *Configure Network Port* panel.

The DSCLI provides the following commands to manage these new network ports:

- **lsnetworkport -l**
  This command shows the server associations, physical port locations, and IP address settings for all ports on the queried Storage Image Facility; see an example in Example 31-2.
- **shownetworkport**
  This command shows the server association, physical location, and IP addresses for a particular port on the Ethernet card; see an example in Example 31-3.
- **setnetworkport**
  This command configures the network ports. Example 31-1 displays a command example and configures the first port on the Ethernet card in server0.

Example 31-1 setnetoworkport command example

```
dscli> setnetworkport -dev IBM.2107-7520781 -ipaddr 9.155.86.128 -gateway
9.155.86.1 -subnet 255.255.255.0
-primary 9.64.163.21 -secondary 9.64.162.21 N9801
```

Example 31-2 shows an output example of l**snetworkport -l**, which provides an overview of all available Ethernet ports on the concerned Storage Image Facility.

Example 31-2 Output of the lsnetworkport command

```
dscli> lsnetworkport -l
Date/Time: 28 August 2006 13:19:55 CEST IBM DSCLI Version: 5.2.200.308 DS:
IBM.2107-7503461
ID    IP Address  Subnet Mask   Gateway Primary DNS Secondary DNS State   Server
Speed    Type            Location
================================================================================
================================================
I9801 9.155.50.53 255.255.255.0 0.0.0.0 9.64.163.21 9.64.162.21   Online  00
1 Gb/sec Ethernet-Copper U7879.001.DQD04X5-P1-C1-T1
I9802 0.0.0.0     0.0.0.0       0.0.0.0 9.64.163.21 9.64.162.21   Offline 00
1 Gb/sec Ethernet-Copper U7879.001.DQD04X5-P1-C1-T2
I9B01 9.155.50.54 255.255.255.0 0.0.0.0 9.64.163.21 9.64.162.21   Online  01
1 Gb/sec Ethernet-Copper U7879.001.DQD04WH-P1-C1-T1
I9B02 0.0.0.0     0.0.0.0       0.0.0.0 9.64.163.21 9.64.162.21   Offline 01
1 Gb/sec Ethernet-Copper U7879.001.DQD04WH-P1-C1-T2
```

Example 31-3 shows an output example of **shownetworkport**, which provides an overview of all settings for a particular Ethernet port.

Example 31-3 Output of shownetworkport for a particular Ethernet port

```
dscli> shownetworkport i9801
Date/Time: 28 August 2006 13:20:00 CEST IBM DSCLI Version: 5.2.200.308 DS:
IBM.2107-7503461
ID            I9801
IP Address    9.155.50.53
Subnet Mask   255.255.255.0
Gateway       0.0.0.0
```


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```
Primary DNS   9.64.163.21
Secondary DNS 9.64.162.21
State         Online
Server        00
Speed         1 Gb/sec
Type          Ethernet-Copper
Location      U7879.001.DQD04X5-P1-C1-T1
```

TPC for Replication server connectivity to the DS6000

For the DS6000, the Replication Manager server connects to the network that connects to the PowerPC® servers in the DS6000. For the DS6000 this is the same network that the Storage Management console connects to because the DS6000 controller or server card contains only a single Ethernet port.

For the DS6000 there is only a single Ethernet port per cluster or server card. This port is shared between the Replication Manager server or servers as well as with one or two Storage Management consoles.

TPC for Replication configuration options

Note that Figure 31-9 on page 481 outlines the basic connectivity idea. For high availability you may consider a second Replication Manager server that also connects to the same IP network as the first server. Currently the Replication Manager server connects only to one Ethernet port out of the two ports on the Ethernet card, which must reside in the first slot of the System p server in the DS8000.

Note that the internal and potential external HMCs connect to the DS8000 through different ports than the Replication Manager server(s).

The communication between the Replication Manager Server and the DS infrastructure is direct as shown in Figure 31-9 on page 481. It is interesting to note that this is different than when the Replication Manager communicates with the SAN Volume Controller, SVC. Between the Replication Manager server and the SVC Nodes is an SVC CIMON-based console that is part of the standard SVC master console.

For more details refer to *Replication Management with IBM TotalStorage Productivity Center,* SG24-7259.

31.11 TPC for Replication monitoring and freeze capability

TPC for Replication always uses the consistency group attribute when you define PPRC paths for Metro Mirror between a primary and a secondary storage server. This provides TPC for Replication with the capability to freeze a Metro Mirror configuration when an incident happens in order to guarantee consistent data at the secondary or backup site.

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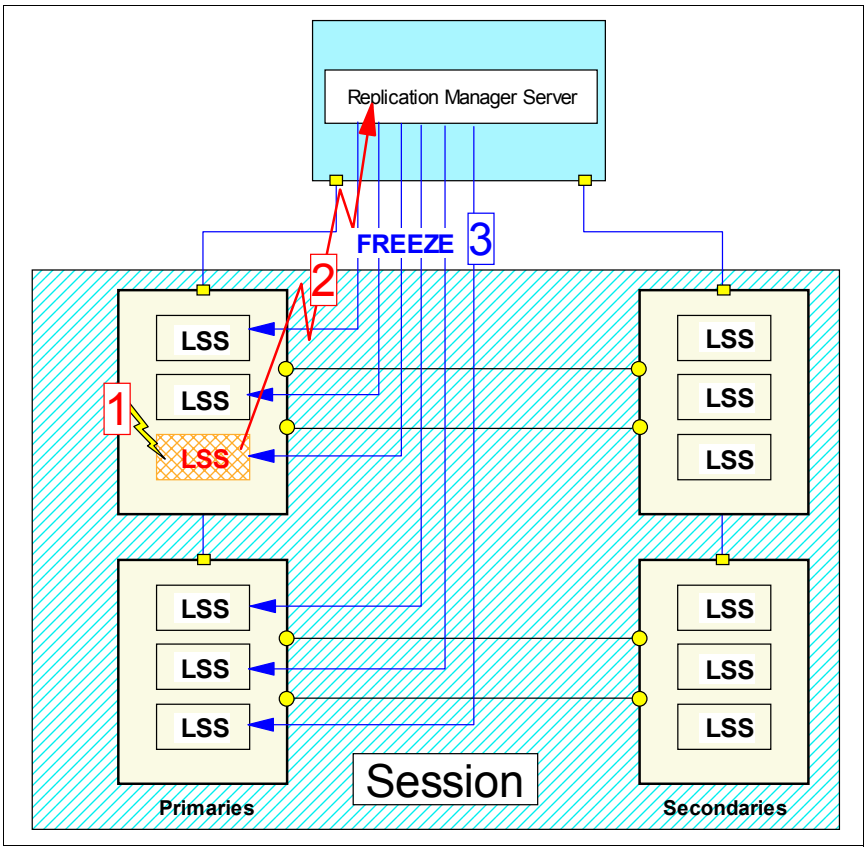

Figure 31-10 TPC for Replication server freeze

The TPC for Replication server listens for incidents from the storage servers and takes action when being notified of a replication error from the concerned storage server.

Figure 31-10 implies a replication error in an LSS that belongs to the session. The TPC server receives a corresponding SNMP trap message from the concerned storage server. The TPC for Replication server then issues a freeze command to all LSSs that are part of the concerned session. This implies a suspend of all PPRC pairs or Copy Sets that belong to this session. During this freeze process, write I/Os are held until the freeze process ends and the TPC server communicates to the storage server to continue processing write I/O requests to the concerned primary volumes in the session.

After that, write I/O can continue to the suspended primary volumes. However, both sites are not in sync any longer but the data on the secondary site is consistent (power drop consistent). This is a so-called *freeze-and-go* policy.

31.12 TPC for Replication heartbeat

Because the connectivity between the TPC for Replication server and the storage servers that the TPC server is managing can fail, the firmware in the storage server waist for a heartbeat signal from the TPC server. TPC for Replication can enable this heartbeat in the corresponding LSS for Metro Mirror sessions.

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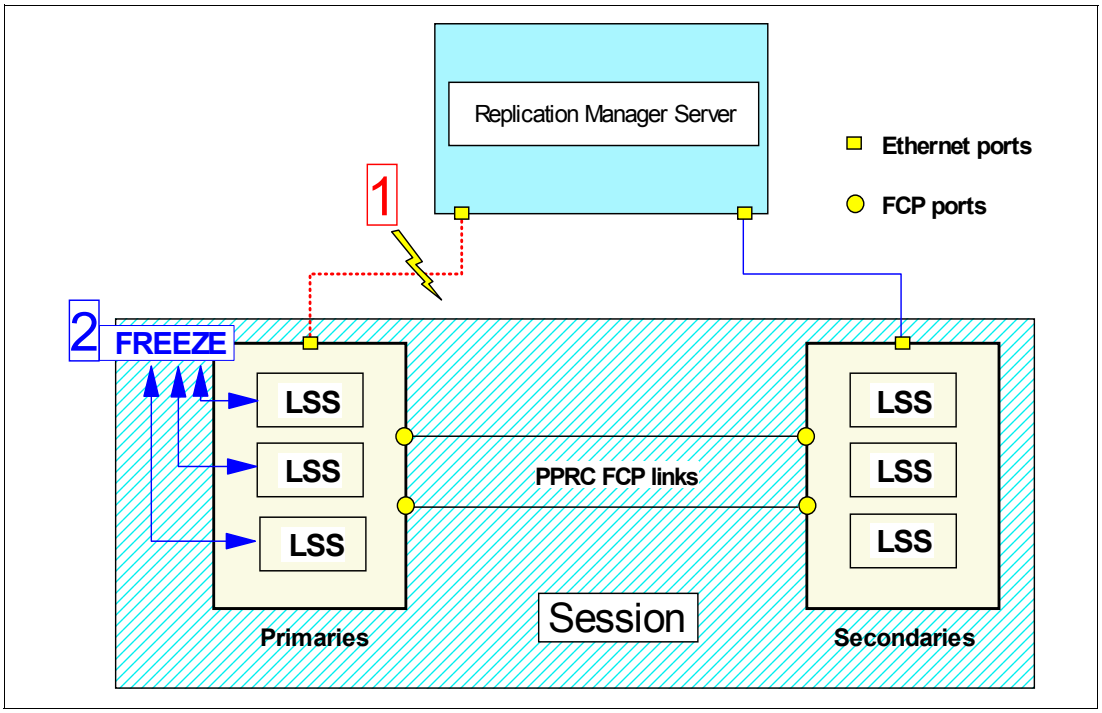

Figure 31-11 LSS heartbeat triggers freeze when connectivity to server fails

Figure 31-11 implies a failing connectivity between the RM server and a primary storage server. Once this heartbeat is set and the storage subsystem cannot communicate its heartbeat information to the RM sever, the storage server internally triggers a freeze to its involved LSSs and their primary volumes. Because this heartbeat is a timer-scheduled function, it is based on the Consistency Group time-out value of each LSS that contains volumes that belong to the concerned session. This session-based heartbeat timer expires after the lowest time-out value of all concerned LSSs.

With more than one storage server involved, the RM server issues freeze commands to all other LSS pairs in the affected session once the heartbeat expired and the RM server could not receive heartbeat information from any one of the involved storage servers.

The disconnected storage server or LSS resumes I/O after the Consistency Group time-out has expired. LSSs or storage servers that may still be connected to the RM server receive a corresponding freeze command from the RM server followed by a run command when a *freeze-and-go* policy has been selected.

Note that Extended Long Busy (ELB), automation window, and freeze period are synonyms for Consistency Group time-out in the above context.

31.13 Supported platforms

The TPC for Replication server can currently run under the following operating systems:

- Windows 2003 Server Edition with SP1
- Windows 2003 Enterprise Edition SP1

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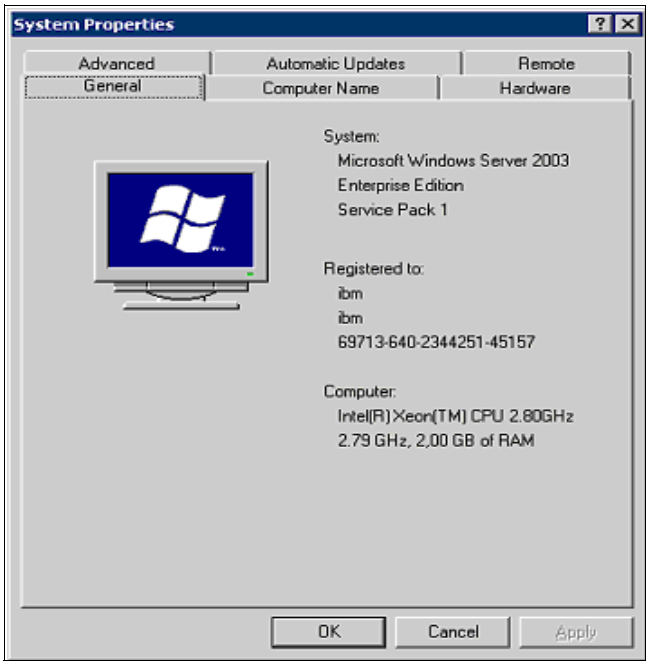

Figure 31-12 Windows 2003 software level

- SUSE Linux Enterprise Server 9 SP2
  Note: SUSE Linux does not support the Two-Site BC configuration.
- Red Hat Enterprise Linux RHEL4 AS 2.1
  For Replication Two-Site BC: Red Hat Enterprise Linux RHEL4 Update 1 SLES9 SP2
- AIX 5.3 ML3

Note: For a TPC for Replication Two-Site BC configuration that involves two servers it is possible to run TPC for Replication on two different operating system platforms.

For the latest software requirements, refer to:

`http://www.ibm.com/servers/storage/support/software/tpcrep/installing.html`

31.14 Hardware requirements for TPC for Replication servers

For Windows and Linux it is suggested to use the following minimum hardware configuration:

- 1.5 GHz Intel® (TM) Pentium (R) III processor
- 2 GB RAM memory
- 10 GB free disk space

When TPC for Replication runs on AIX, the following minimum hardware configuration is suggested:

- Server p, IBM POWER4™ (TM) or IBM POWER5™ (TM) processor, 1 GHz
- 2 GB RAM memory
- 10 GB free disk space

Disk space is required to hold data in DB2 databases and WebSphere (R) Express Application Server code besides the actual TPC for Replication server code.

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You may refer to the following Web site for the latest information on hardware requirements:

`http://www-03.ibm.com/servers/storage/support/software/tpcrep/installing.html`

31.15 TPC for Replication GUI

This section describes the graphical user interface (GUI) that is used to communicate with the the Replication server. Additional details can be found in the documents mentioned at the beginning of this chapter.

TPC for Replication provides a graphical user interface (GUI) to manage and monitor any Copy Services configuration and Copy Services operations. This GUI is Web browser-based and does not rely on any other product such asTotalStorage Productivity Center and IBM Director.

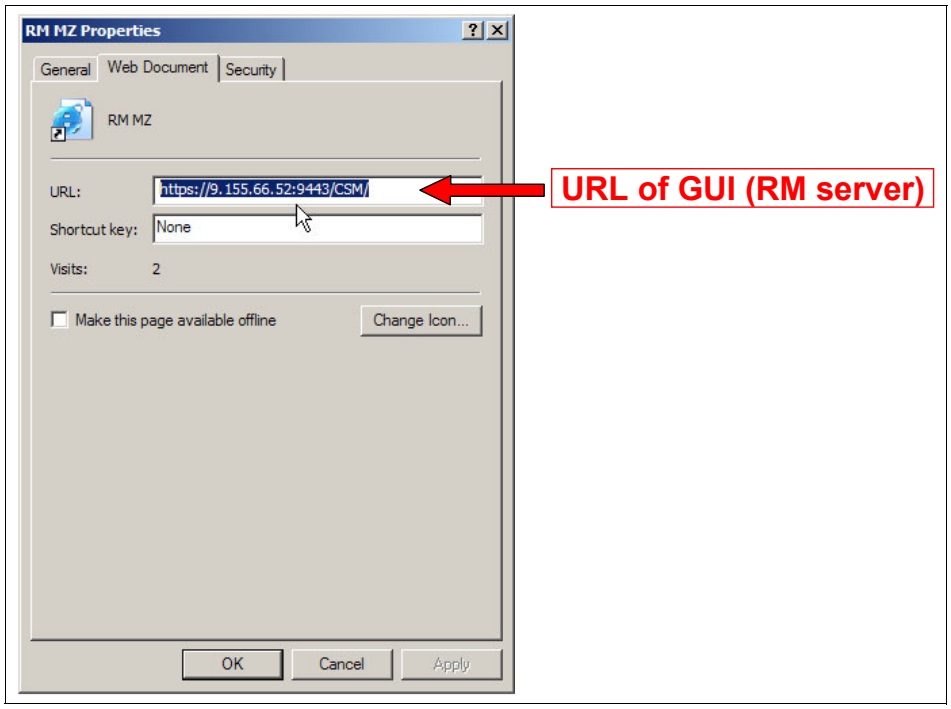

Figure 31-13 GUI URL determined during Replication Manager install time

The GUI is simply called through an Internet browser like MS Internet Explorer or Mozilla Firefox, is intuitive, easy to use, and performs very well. The panel structure is not too deep and makes it possible to quickly transition to any application through a hyperlink-based menu.

Figure 31-14 on page 488 displays the TPC for Replication GUI and its components, used between the client on the user machine and the server component on the server machine.

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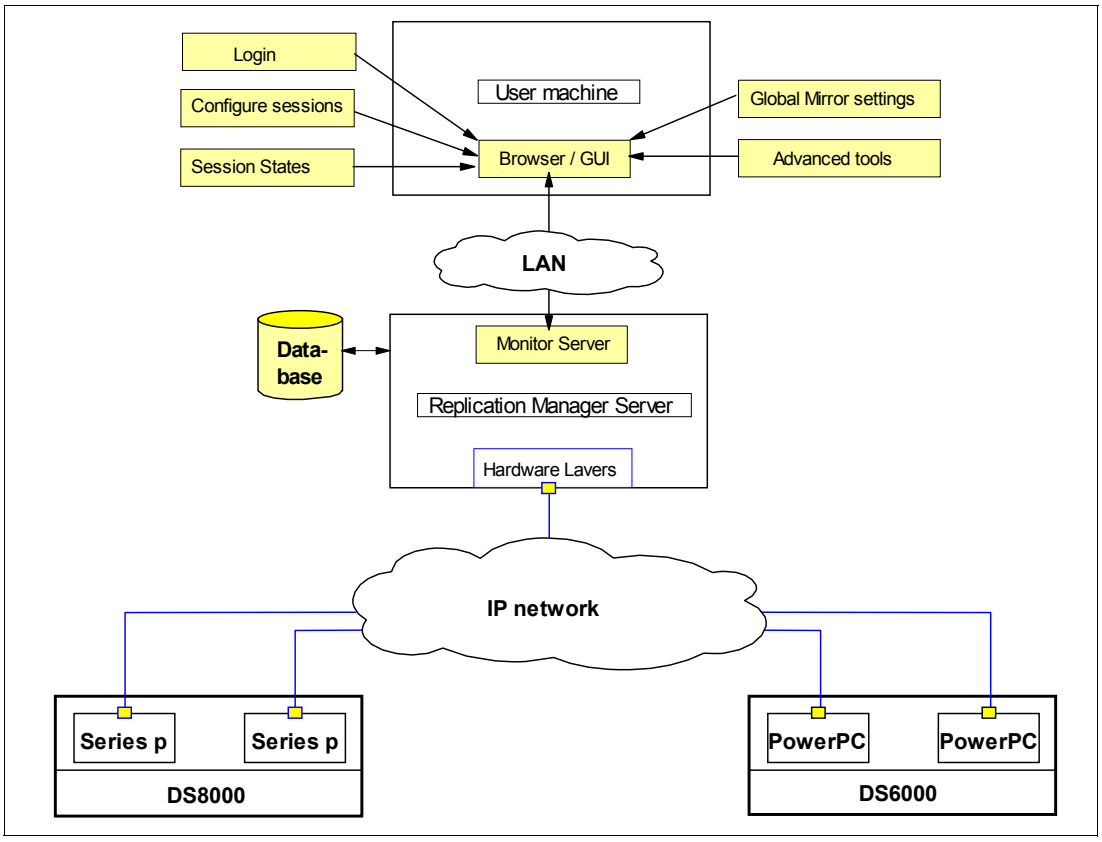

Figure 31-14 TPC for Replication GUI

The Web-based client that runs on the user's machine contains the GUI client, a presentation component. This software piece on the user's machine is highly optimized to minimize data traffic over the LAN to the RM server.

The GUI server component runs on the RM server machine, which contains the interface to the function code in the connected storage servers and is usually closely installed to the storage servers that interface with the RM server.

31.15.1 Connect to the TPC for Replication GUI

You connect to the GUI by specifying the IP address of the TPC for Replication server in your Web browser.

This will present the sign-on panel shown in Figure 31-15 on page 489.

Once you sign out from the RM server, the same panel is also displayed.

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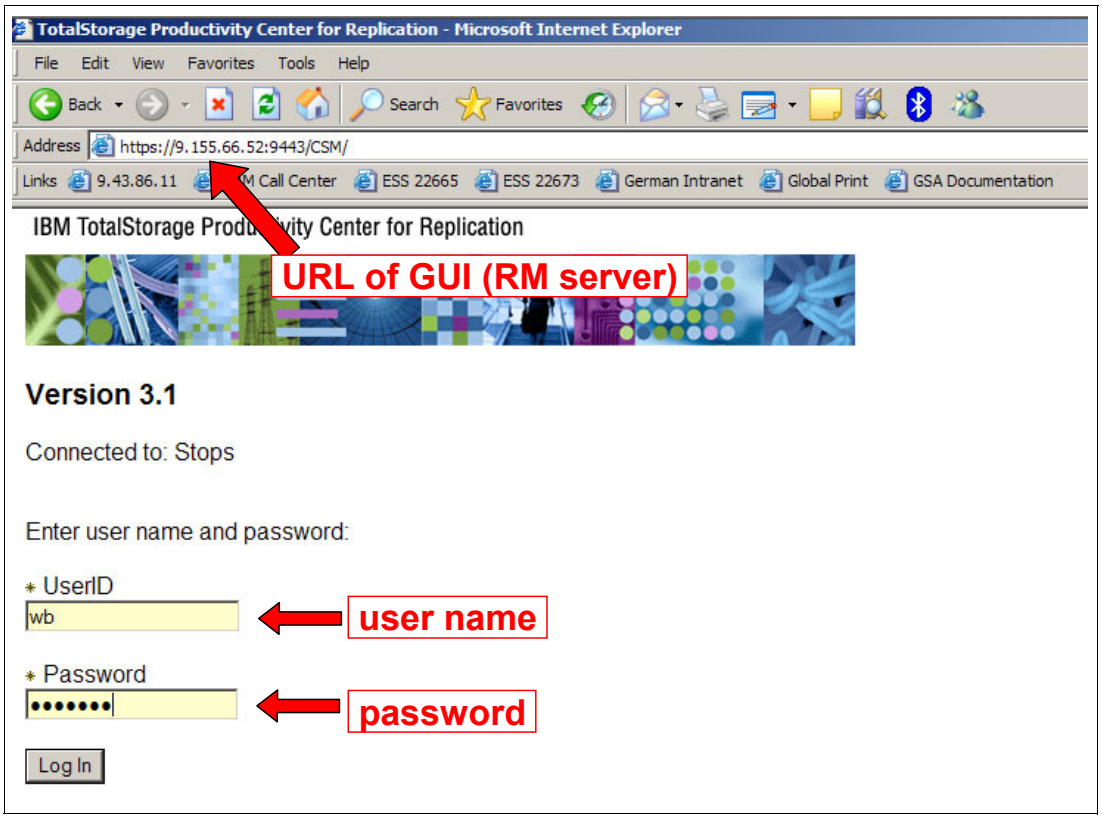
TotalStorage Productivity Center for Replication - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address https://9.155.66.52:9443/CSM/
Links 9.43.86.11 M Call Center ESS 22665 ESS 22673 German Intranet Global Print GSA Documentation
IBM TotalStorage Produ vity Center for Replication
URL of GUI (RM server)
Version 3.1
Connected to: Stops
Enter user name and password:
* UserID
wb
user name
* Password
password
Log In

Figure 31-15 Launch the Replication Manager GUI

You specify a user ID as a text string on the UserID field and a password in a hidden text field. User IDs are defined and set up in the RM server system.

31.15.2 Health Overview panel

After a successful login into the Replication Manager server, the Health Overview panel is displayed, as shown in Figure 31-16 on page 490.

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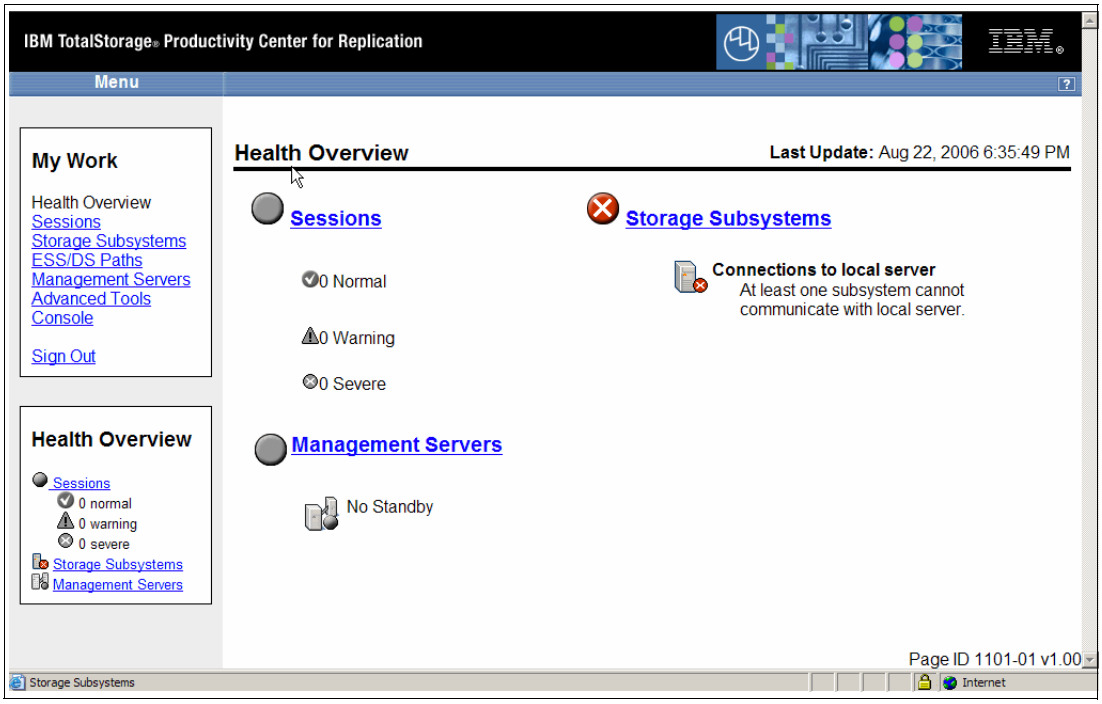

Figure 31-16 Health Overview panel

This health panel displays an overall summary of the Replication Manager system status. It actually shows information very similar to what is also shown in the small box at the left lower corner of this panel. This small health overview box at the lower left corner is always present.

The Health Overview panel, however, provides some more details, for example an overall status of the following:

- Sessions
- Connected storage subsystems
- Management servers

Figure 31-16 reports that all sessions are in normal status and working fine. There is no high availability server environment and one or more storage servers cannot be reached by the Replication Manager.

The upper left box in this panel, labeled *My Work,* provides a list of applications that you can use to manage various aspects of a Copy Services environment.

Health Overview
This is the currently displayed panel, as Figure 31-16 shows.

Sessions
This hyperlink brings you to the application that manages all sessions. This is the application which you will use the most.

Storage Subsystems
Here you start when you define storage servers to the RM server that are going to be used for Copy Services.

ESS/DS Paths
This link allows you to manage everything that is related to PPRC path management.

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Management Servers
This link leads you to the application that manages the RM server configuration.

Advanced Tools
Here you may trigger to collect diagnostic information or set the refresh cycle for the displayed data.

Console
This link opens a log that contains all activities of the user and its results.

31.15.3 Sessions panel

This is the panel of all sessions within the RM server.

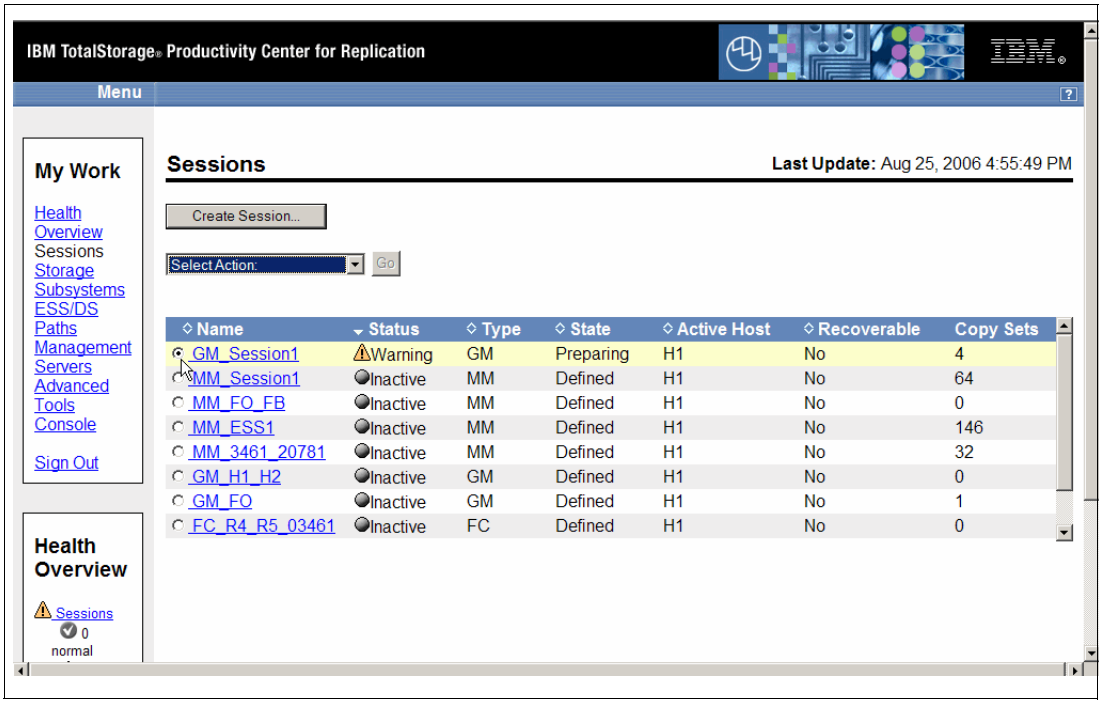

Figure 31-17 Sessions overview

Each session comprises a number of Copy Sets that may be distributed across LSSs and physical storage servers. The session name functions as a token which is used to apply any action against the session or all the volumes that belong to that session.

Figure 31-18 on page 492 illustrates that you first select a session and then choose the action you want to perform against that session.

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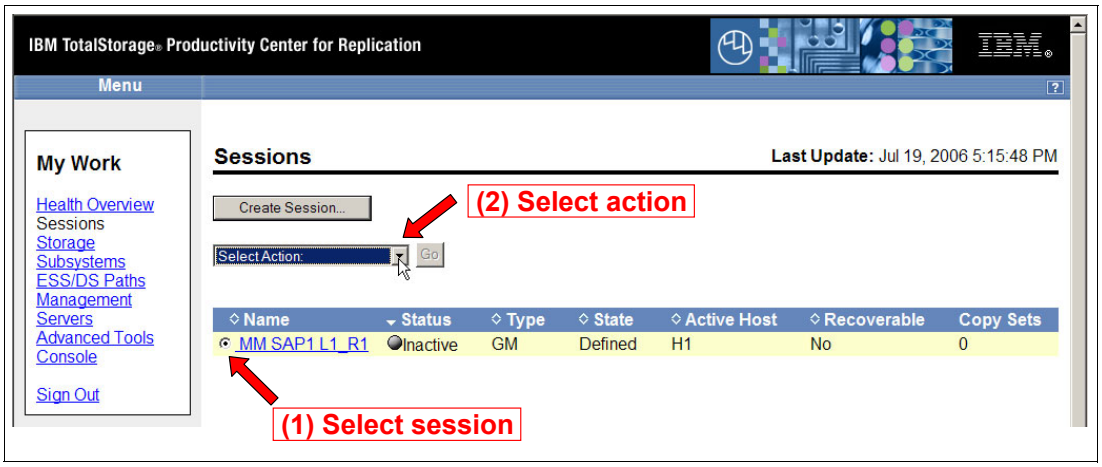

Figure 31-18 About to create Copy Set(s) to sessions

Figure 31-19 displays a next possible step to perform an action against a session. After selecting the session *GM_Session1* shown in Figure 31-17 on page 491, you may select any action from the action list shown in Figure 31-19.

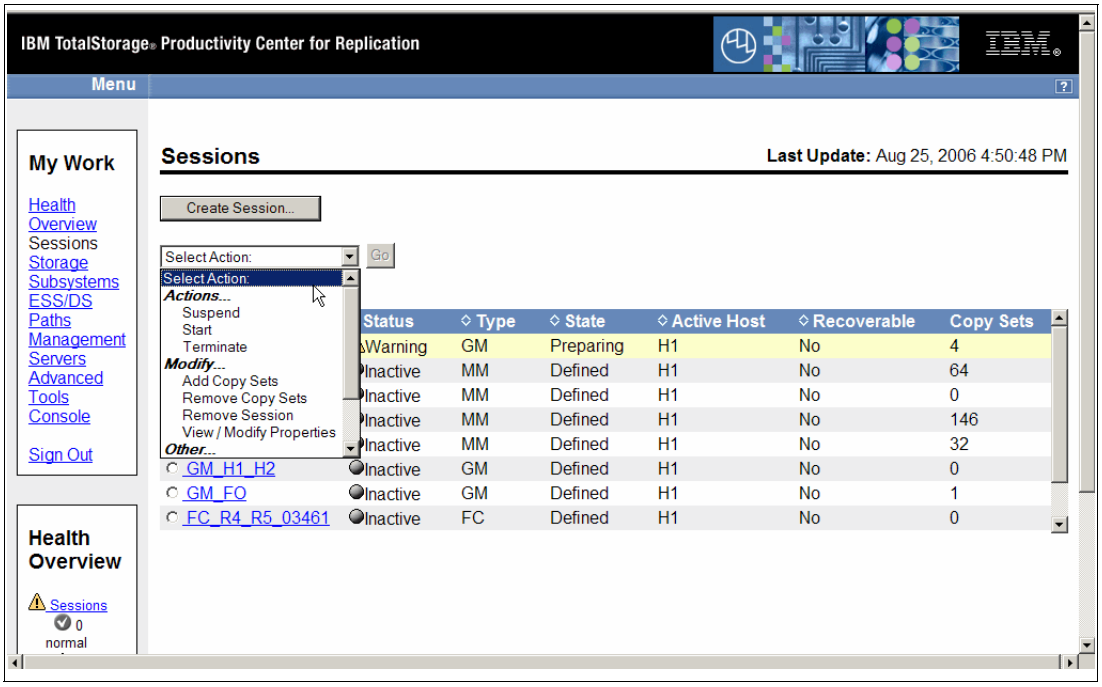

Figure 31-19 Actions against a session

This may be an action against the entire session, such as suspending all volumes within the session. It is also used to modify an existing session and add or remove Copy Sets.

31.15.4 Storage Subsystems panel

Figure 31-20 on page 493 displays all storage subsystems currently connected to the RM server.

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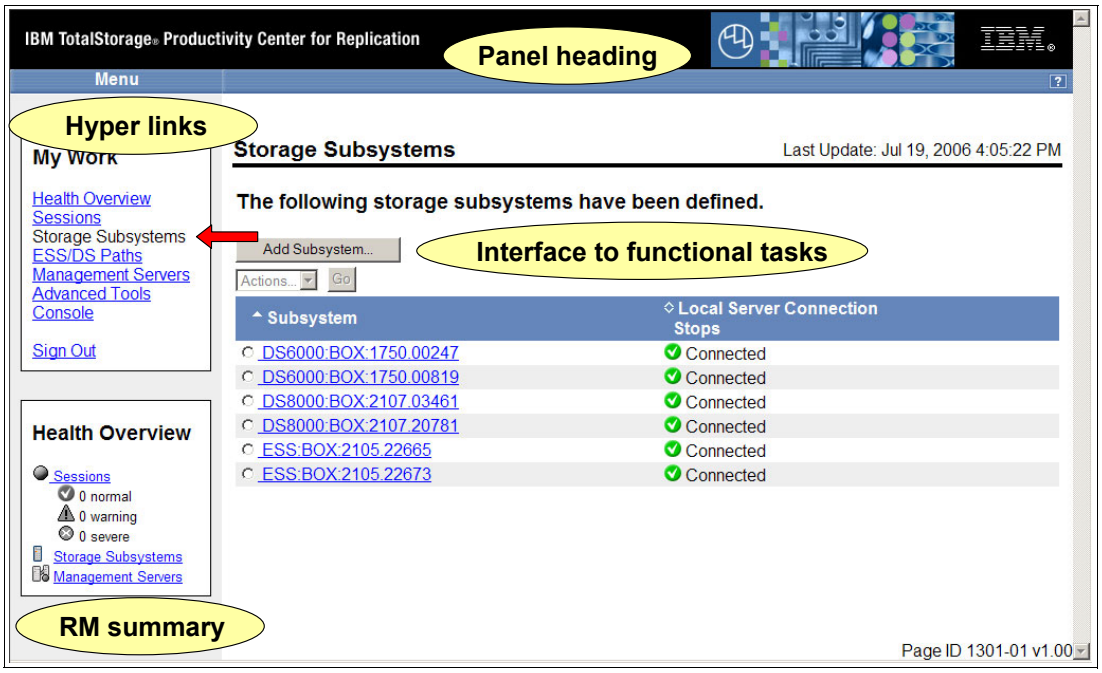

Figure 31-20 GUI basic layout

Using the Add Subsystem button you can define another storage subsystem to the RM server.

The panel used to add a new server is shown in Figure 31-22 on page 494.

Figure 31-21 displays the available action list. From this list you select, for instance, the View/Modify Details action and apply it to the previously selected storage server.

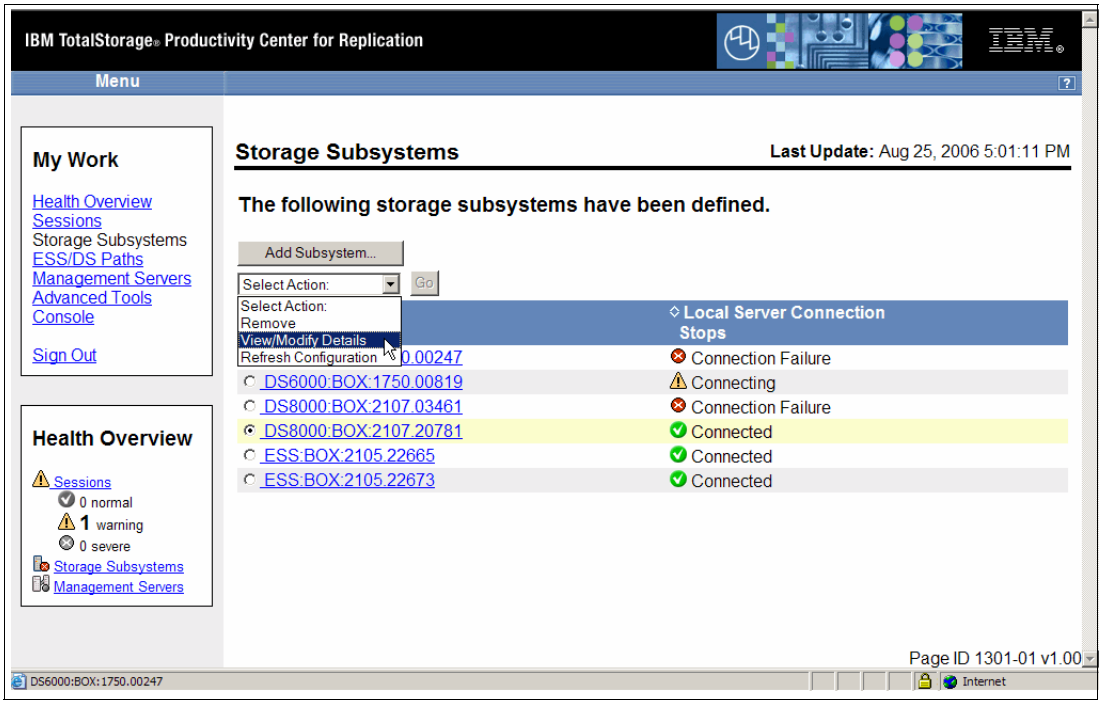

Figure 31-21 Select the storage subsystem and the View/Modify Details action

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The selected storage subsystem connectivity details are now displayed, as shown in Figure 31-22.

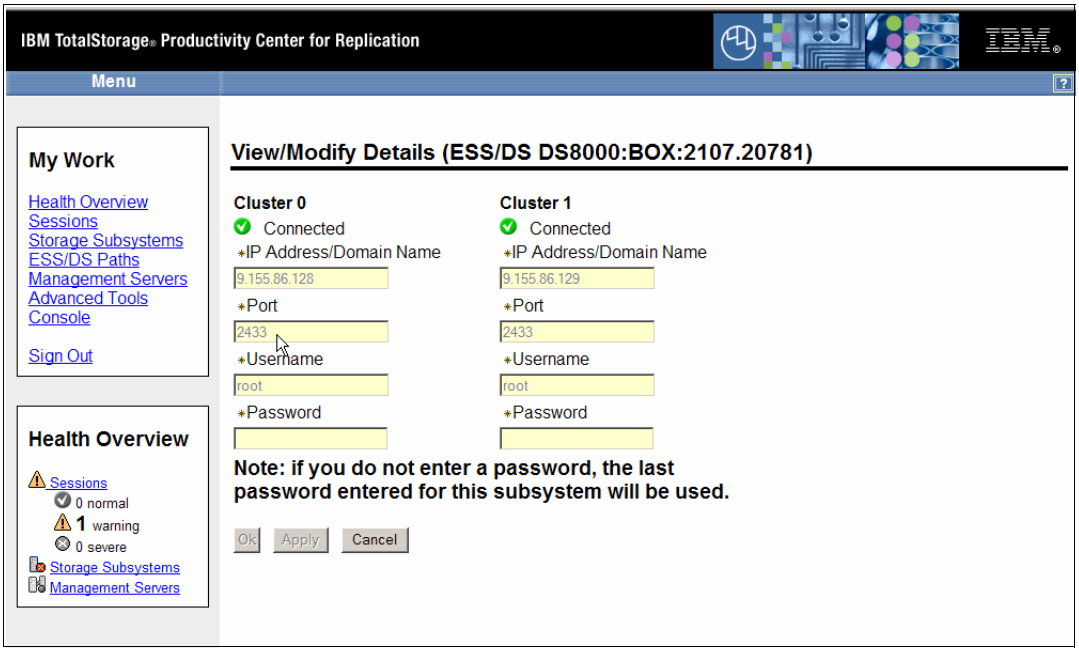

Figure 31-22 Storage subsystem details

You usually use the storage subsystem application only to connect a storage server to the RM server. Figure 31-22 also shows the standard port used by the RM server to communicate with the storage server. All the other fields are self-explanatory.

31.15.5 Path Management panel

Figure 31-23 displays the entry panel to manage PPRC paths.

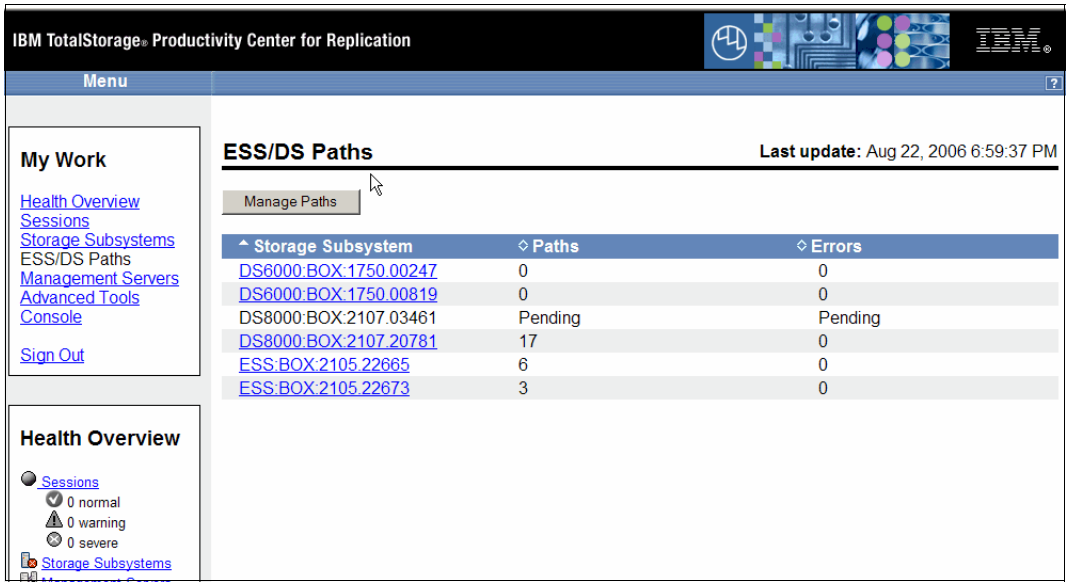

Figure 31-23 Path overview panel

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Clicking the **Manage Paths** button triggers the path wizard to help you define a new PPRC path or remove existing PPRC paths.

Clicking on a storage subsystem gives you a list of all the existing paths currently defined for the selected storage subsystem. Figure 31-24 displays all the defined PPRC paths for the selected LSS and the ports used for these PPRC paths.

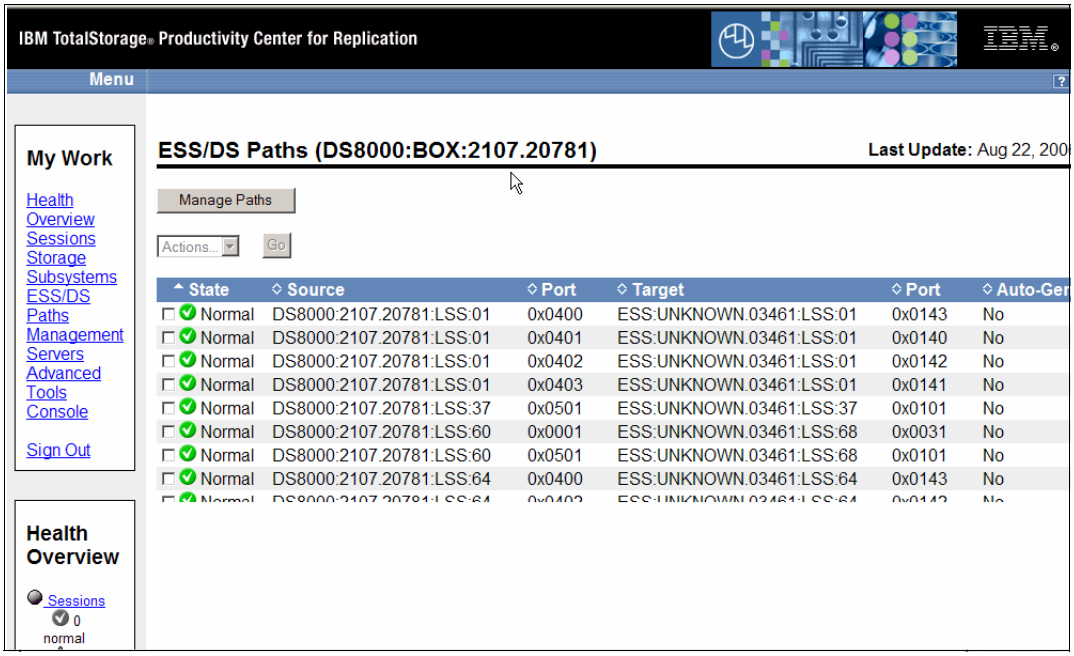

Figure 31-24 Path overview of a DS8000

You may select any path here and the only available action in this case is to then remove the selected path(s).

31.15.6 RM Server Configuration panel

The panel in Figure 31-25 on page 496 displays the status of the Replication management server or servers.

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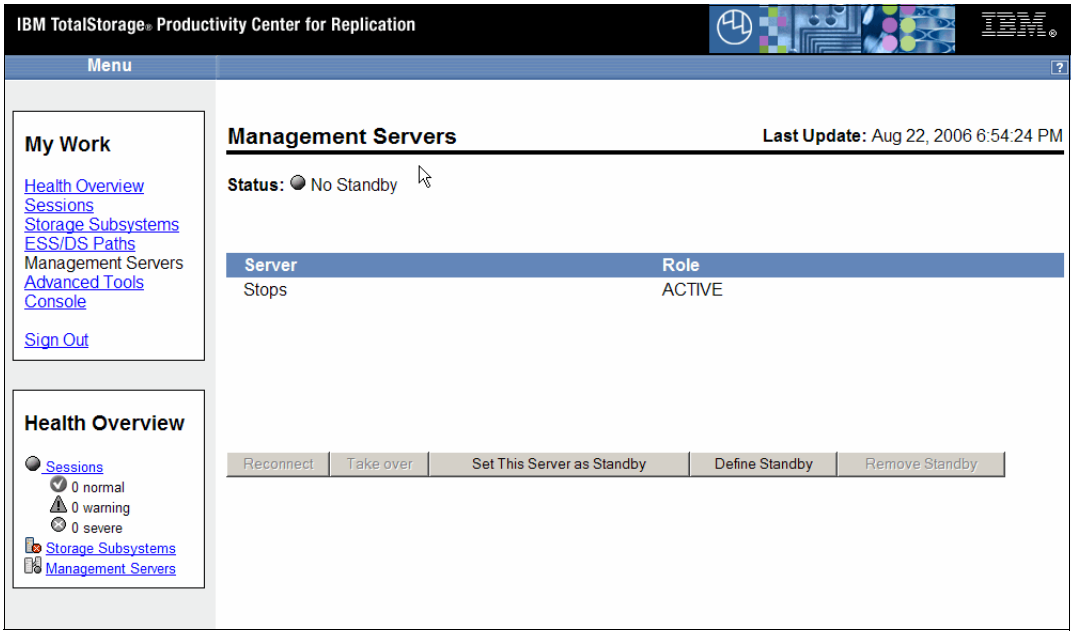

Figure 31-25 Replication Management servers

Figure 31-25 shows only one server named *Stops,* which is an active server.

When it exists, a second row will show the potential second server, which is in the status Standby. A panel with two servers has a slightly different appearance than what is shown in Figure 31-25.

You use this panel for basic operations such as defining a server as Standby or to *take over* in the event of a disaster.

In the case of two servers, each server manages its own DB2 database. The communication between the servers is performed through the LAN to which both servers are connected.

31.15.7 Advanced Tools panel

Figure 31-26 on page 497 displays a panel through which you handle some specific tasks.

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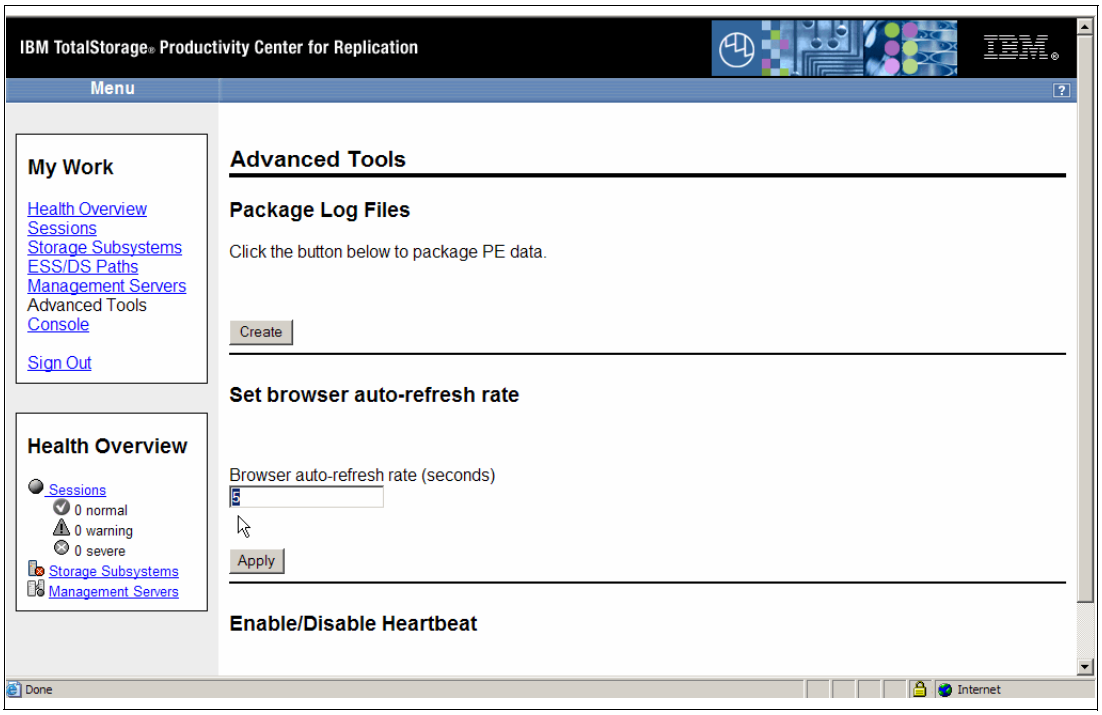

Figure 31-26 Advanced tools option

Specific tasks in this context are tasks to create a diagnostic package or to change the automatic refresh rate of the GUI. A third task is to enable or disable the heartbeat that happens between the Replication Manager server and the connected storage servers; see also 31.12, “TPC for Replication heartbeat” on page 484.

The diagnostic package contains all RM logs. Its location on the RM server is shown on the screen.

The browser refresh rate is currently a value between 5 t0 3600 seconds. The default value is 30 seconds.

31.15.8 Console log

Figure 31-27 on page 498 displays an example of a console log. This panel shows a list of the most recent commands which this user entered through the GUI.

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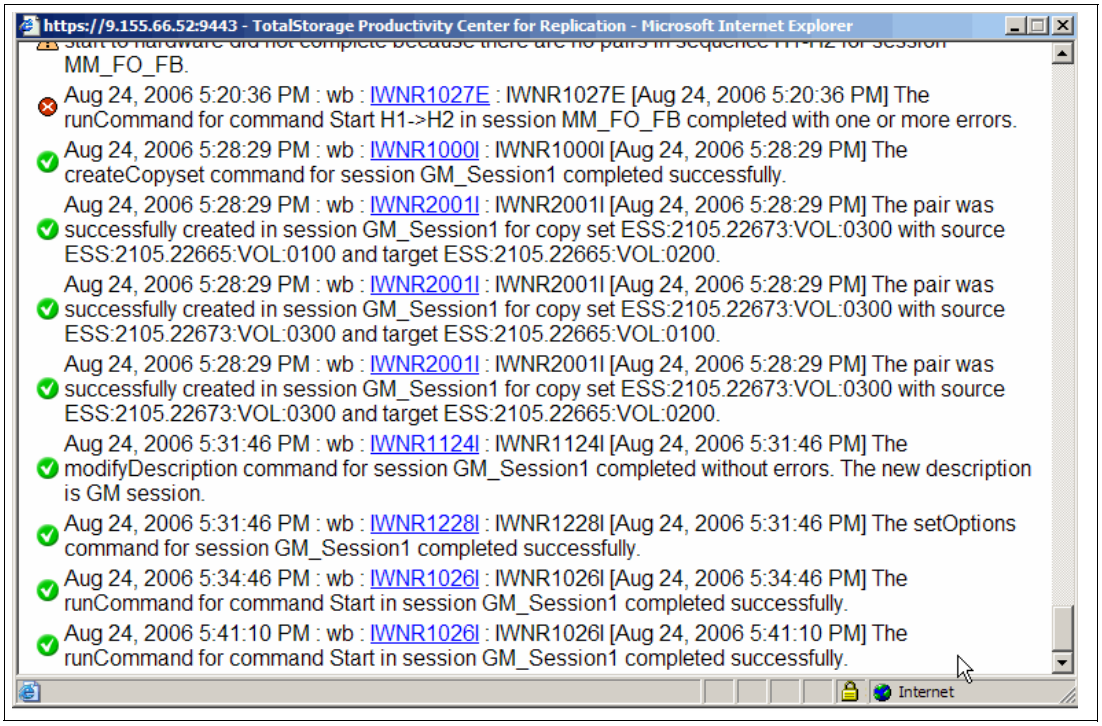
https://9.155.66.52:9443 - TotalStorage Productivity Center for Replication - Microsoft Internet Explorer
MM_FO_FB.
Aug 24, 2006 5:20:36 PM : wb : IWNR1027E : IWNR1027E [Aug 24, 2006 5:20:36 PM] The runCommand for command Start H1->H2 in session MM_FO_FB completed with one or more errors.
Aug 24, 2006 5:28:29 PM : wb : IWNR1000I : IWNR1000I [Aug 24, 2006 5:28:29 PM] The createCopyset command for session GM_Session1 completed successfully.
Aug 24, 2006 5:28:29 PM : wb : IWNR2001I : IWNR2001I [Aug 24, 2006 5:28:29 PM] The pair was successfully created in session GM_Session1 for copy set ESS:2105.22673:VOL:0300 with source ESS:2105.22665:VOL:0100 and target ESS:2105.22665:VOL:0200.
Aug 24, 2006 5:28:29 PM : wb : IWNR2001I : IWNR2001I [Aug 24, 2006 5:28:29 PM] The pair was successfully created in session GM_Session1 for copy set ESS:2105.22673:VOL:0300 with source ESS:2105.22673:VOL:0300 and target ESS:2105.22665:VOL:0100.
Aug 24, 2006 5:28:29 PM : wb : IWNR2001I : IWNR2001I [Aug 24, 2006 5:28:29 PM] The pair was successfully created in session GM_Session1 for copy set ESS:2105.22673:VOL:0300 with source ESS:2105.22673:VOL:0300 and target ESS:2105.22665:VOL:0200.
Aug 24, 2006 5:31:46 PM : wb : IWNR1124I : IWNR1124I [Aug 24, 2006 5:31:46 PM] The modifyDescription command for session GM_Session1 completed without errors. The new description is GM session.
Aug 24, 2006 5:31:46 PM : wb : IWNR1228I : IWNR1228I [Aug 24, 2006 5:31:46 PM] The setOptions command for session GM_Session1 completed successfully.
Aug 24, 2006 5:34:46 PM : wb : IWNR1026I : IWNR1026I [Aug 24, 2006 5:34:46 PM] The runCommand for command Start in session GM_Session1 completed successfully.
Aug 24, 2006 5:41:10 PM : wb : IWNR1026I : IWNR1026I [Aug 24, 2006 5:41:10 PM] The runCommand for command Start in session GM_Session1 completed successfully.
Internet

Figure 31-27 Console log

Besides the commands this log also shows whether the command succeeded, and a message number functions at the same time as a hyperlink to more detailed text about the result of the concerned command execution.

31.16 Command Line Interface to TPC for Replication

Besides the GUI you may also manage TPC for Replication through a command line interface (CSMCLI).

As with the DSCLI for DS8000 and DSCLI for DS6000, the CSMCLI command structure is similar for all three CLI products, such as **mk**... for make, **ch**... for change, etc.

CSMCLI is also invoked in the same fashion as the DSCLI for the DS products and provides three different modes:

- Singe-shot mode
- Interactive mode
- Script mode

Example 31-4 shows a single-shot command.

Example 31-4 Single-shot CLI command

```
> csmcli lsdevice -devtype ds
```

To execute more than one command you may start the CLI program and perform the commands at the shell prompt, as Example 31-5 on page 499 shows.

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Example 31-5 Interactive CLI commands

```
... start csmcli ...
csmcli> lsdevice -devtype ds
csmcli> lsdevice -devtype ess
```

The third mode is the script mode, running commands out of a file.

Example 31-6 Script mode to execute CLI commands

```
... start csmcli ...
csmcli -script ~/rm/scrtips/devreport
```

In contrast to DSCLI for the DS storage servers, the CSMCLI currently does not use a **`-profile`** option.

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32

GDPS overview

Today's on demand data centers must be resilient enough to handle planned and unplanned system outages without impacting the business of the enterprise.

Most solutions that help provide continuous IT service availability are based on cluster server software, mirrored storage, and redundant networks. When a failure occurs, an integrated disaster recovery solution will, in a predetermined fashion, execute a set of tasks to restart the operating system, recover storage servers and networks, and restart applications on a different set of servers and storage in another location. This level of functionality is also defined as *IT continuous availability*.

GDPS or Geographically Dispersed Parallel Sysplex is such a full function solution and provides various levels of IT continuous availability through different implementation levels. GDPS as a continuous availability and near-transparent disaster recovery solution is based on Parallel Sysplex server functionality and disk mirroring utilizing Metro Mirror and Global Mirror.

This chapter provides an overview of the various features that GDPS offers. More information is available in *IBM System Storage Business Continuity Solutions Guide*, SG24-6547 and *GDPS Family - An Introduction to Concepts and Capabilities*, SG24-6374-01.

Also see the following URLs:

`http://www.ibm.com/servers/eserver/zseries/gdps/`
`http://www.ibm.com/services/storage`

Note that GDPS is a continuous availability solution for System z and is an IBM implementation service and not a product.

Important: The various GDPS offerings are not products. They are delivered as IBM Global Service offerings.

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32.1 GDPS solution offerings

GDPS is a family of offerings, for single site or multi-site application availability solution, with the capability to manage the remote copy configuration and storage subsystems, automate System z operational tasks, manage and automate planned reconfigurations, and do failure recovery from a single point of control.

GDPS is an integrated end-to-end solution composed of software automation, software, servers and storage, networking, and IBM Global Services to configure and deploy the solution, as shown in Figure 32-1. The GDPS solution has components in the areas denoted by dark shading.

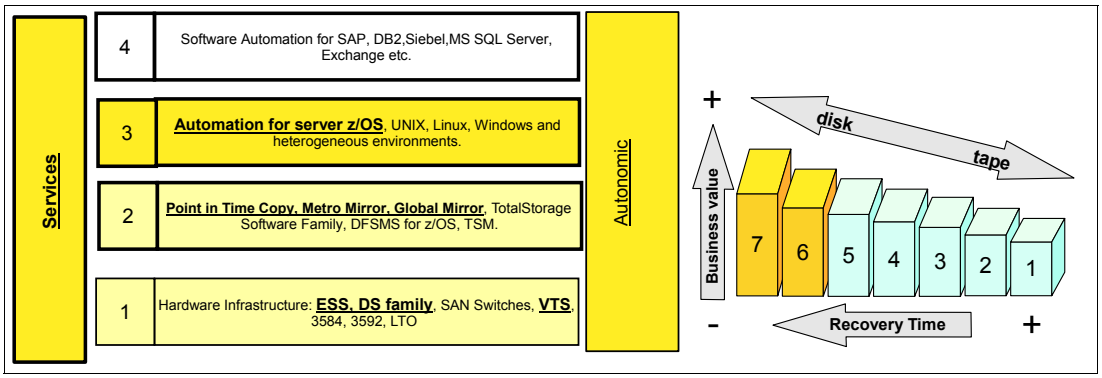

Figure 32-1 Positioning of GDPS solution offerings

The benefits of GDPS are: a highly reliable, highly automated IT infrastructure solution with a System z-based control point, which can provide very robust application availability.

GDPS is enabled by means of key IBM technologies and architectures.

GDPS supports both the synchronous (Metro Mirror) as well as the asynchronous (z/OS Global Mirror or Global Mirror) forms of remote copy. GDPS also supports Peer-to-Peer Virtual Tape Server (PtP VTS) for remote copying of tape data. The GDPS solution is a non-proprietary solution, working with IBM as well as Other Equipment Manufacturer (OEM) disk vendors, as long as the vendor meets the specific functions of the Metro Mirror, Global Mirror, and z/OS Global Mirror architectures required to support GDPS functions.

GDPS automation manages and protects IT services by handling planned and unplanned exception conditions. Depending on the GDPS configuration selected, availability can be storage resiliency only, or can provide near-continuous application and data availability. Regardless of the specific configuration variation, GDPS provides a System z-based Business Continuity automation and integration solution to manage both planned and unplanned exception conditions.

To attain high levels of continuous availability and near-transparent DR, the GDPS solution is based on geographical clusters and disk mirroring.

Figure 32-2 is a diagram of some of the many possible components supported in a GDPS configuration. GDPS is configured to meet the specific client requirements. Not all of the components shown in Figure 32-2 are necessary in all GDPS offerings or GDPS solutions.

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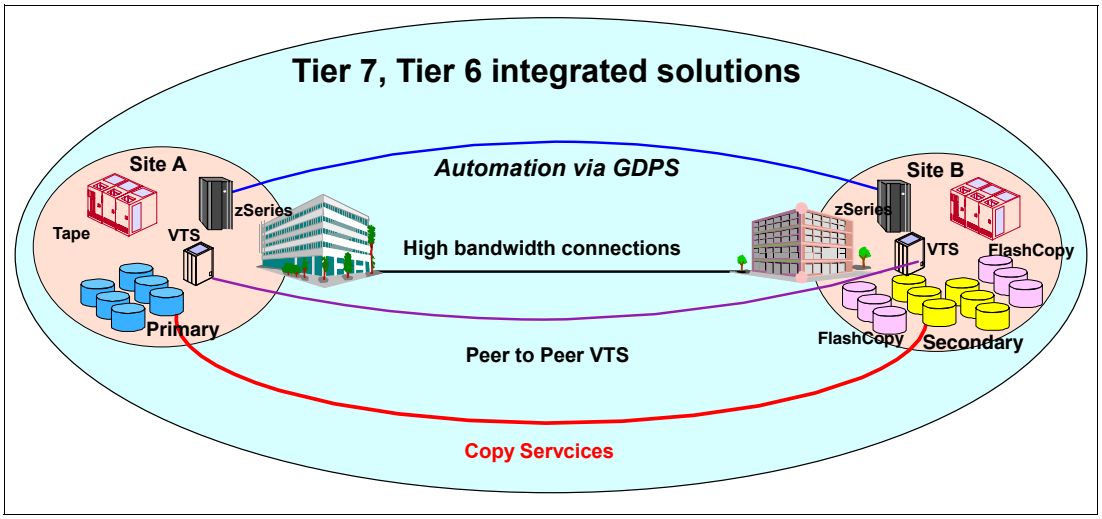

Figure 32-2 GDPS integrates many components

The GDPS family of System z Business Continuity solutions consists of two major offering categories, and each category has several suboffering. Each GDPS solution is delivered through IBM Global Services, and is specifically tailored to fit a specific set of client recovery needs, budgetary requirements, physical distance and infrastructure, and other factors.

The three major categories of GDPS solutions are:

- GDPS/PPRC solutions, based on Metro Mirror. Metro Mirror was formerly known as Peer-to-Peer Remote Copy (PPRC).
- GDPS/XRC solutions, based on z/OS Global Mirror. z/OS Global Mirror was formerly known as Extended Remote Copy (XRC).
- GDPS/GM (Global Mirror) solutions, based on Global Mirror.

The suboffering within these three GDPS major categories include the following:

- GDPS/PPRC
  - GDPS/PPRC, a Tier 7 solution
  - GDPS/PPRC HyperSwap Manager, a Tier 6 solution
  - RCMF/PPRC, a remote copy management solution for PPRC
- GDPS/XRC
  - GDPS/XRC, a Tier 7 solution
  - RCMF/XRC, a remote copy management solution for XRC

Certain of the above GDPS offerings can also be combined into 3-site GDPS solutions, providing Tier 7 recoverability in a multi-site environment.

32.1.1 GDPS/PPRC overview

GDPS/PPRC is designed to manage and protect IT services by handling planned and unplanned exception conditions, and maintain data integrity across multiple volumes and storage subsystems. By managing both planned and unplanned exception conditions, GDPS/PPRC can help to maximize application availability and provide business continuity.

GDPS/PPRC is capable of the following attributes:

- Near continuous availability solution

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- Near transparent D/R solution
- Recovery Time Objective (RTO) less than an hour
- Recovery Point Objective (RPO) of zero (optional)
- Protects against localized area disasters with a typical distance between sites limited to up to 100 km fiber distance

The GDPS/PPRC solution offering combines System z Parallel Sysplex capability and ESS, DS6000, and/or DS8000 Metro Mirror disk mirroring technology to provide a Business Continuity solution for IT infrastructures that have System z at the core. GDPS/PPRC offers efficient workload management, system resource management, Business Continuity or Disaster Recovery for z/OS servers and open system data, and provides data consistency across all platforms using the Metro Mirror Consistency Group function.

The GDPS solution uses automation technology to provide end-to-end management of z/Servers, disk mirroring, tape mirroring, and workload shutdown and startup. GDPS will manage the infrastructure to minimize or eliminate the outage during a planned or unplanned site failure. Critical data is disk mirrored, and processing is automatically restarted at an alternate site in the event of a primary planned site shutdown or site failure.

GDPS/PPRC automation provides scalability to insure data integrity at a very large number of volumes, across hundreds or thousands of Metro Mirror pairs.

32.1.2 PPRC and HyperSwap

Exclusive to GDPS in the PPRC environment is HyperSwap. This function is designed to broaden the near continuous availability attributes of GDPS/PPRC by extending the Parallel Sysplex redundancy to disk subsystems. The HyperSwap function can help significantly reduce the time needed to switch to the secondary set of disks while keeping the z/OS systems active together with their applications.

GDPS/PPRC V3.2, the HyperSwap function, exploits the Metro Mirror Failover/Failback (FO/FB) function.

For planned reconfigurations, FO/FB may reduce the overall elapsed time to switch the disk subsystems, thereby reducing the time that applications may be unavailable to users.

For unplanned reconfigurations, FO/FB allows the secondary disks to be configured in the suspended state after the switch and record any updates made to the data. When the failure condition has been repaired, resynchronizing back to the original primary disks requires only the changed data to be copied, thus eliminating the need to perform a full copy of the data. The window during which critical data is left without Metro Mirror protection following an unplanned reconfiguration is thereby minimized.

32.1.3 RCMF/PPRC overview

Remote Copy Management Facility/PPRC (RCMF/PPRC) is the name given to a subset of the GDPS/PPRC offerings. RCMF/PPRC includes the storage interface management functions only.

RCMF/PPRC provides panels and code that execute under NetView®, and an operator interface for easier management of a remote copy configuration in setup, initialization, and any planned outage operational mode. This provides benefits for businesses looking to improve their management of PPRC for normal running circumstances.

Note that RCMF/PPRC does not provide any monitoring capability and is not designed to notify the operator of an error in the remote copy configuration. Thus RCMF does not support

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the Freeze function for GDPS/PPRC, FlashCopy automation, or the unplanned outage functions available through the other versions of GDPS.

RCMF/PPRC is positioned as a remote copy management control tool, designed to make the task for operators to stop and start remote copy sessions much easier.

The highlights of RCMF/PPRC include:

- Central point of control - full screen
- Global PPRC configuration awareness
- Functional, tree-structured interface
- TSO commands not needed
- Initialize and maintain Remote Copy configuration
- Single keystroke function invocation
- Initiate functions per pair, subsystem, or all
- Automatically establish target configuration at system startup
- Supports adding, moving, removing pairs, subsystems and links
- RCMF does not manage unplanned outage secondary data consistency
- Drive Peer-to-Peer/Dynamic Address Switching (P/DAS)
- User-initiated status and exception reporting
- Can run as a NetView application - System Automation not required

32.1.4 GDPS/XRC overview

IBM System Storage z/OS Global Mirror, formerly known as Extended Remote Copy (XRC), is a combined hardware and z/OS software asynchronous remote copy solution for System z data. z/OS Global Mirror is designed to provide premium levels of scalability, reaching into the tens of thousands of System z volumes. Consistency of the data is maintained via the Consistency Group function within the System Data Mover.

GDPS/XRC includes automation to manage z/OS Global Mirror remote copy pairs and automates the process of recovering the production environment with limited manual intervention, including invocation of CBU, thus providing significant value in reducing the duration of the recovery window and requiring less operator interaction.

GDPS/XRC provides the following attributes:

- Disaster recovery solution
- RTO between an hour to two hours
- RPO less than two minutes, typically 3-5 seconds
- Protects against localized as well as regional disasters; unlimited distance between sites
- Minimal remote copy performance impact

32.1.5 RCMF/XRC overview

Remote Copy Management Facility/XRC (RCMF/XRC) is a subset of GDPS/XRC that provides the capability to manage the z/OS Global Mirror configuration for planned and unplanned outages. RCMF/XRC is not intended to manage the system and workload environment. RCMF/XRC provides a central point of control of z/OS Global Mirror disk mirroring configurations where the environment does not require more than one SDM. Environments that require multiple SDMs and/or coupled SDMs will require the full GDPS/XRC.

RCMF/XRC solution highlights include:

- Functional full screen interface
- Initialize and maintain z/OS Global Mirror Remote Copy configuration

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- User-initiated status collection and exception monitoring
- NetView application, does not require System Automation for z/OS

RCMF/XRC provides panels and code that execute under NetView, and an operator interface for easier management of a remote copy z/OS Global Mirror configuration in setup, initialization, and any planned outage operational mode. This provides benefits for businesses looking to improve their management of XRC for normal running circumstances.

RCMF/XRC is positioned as a remote copy management control tool, designed to make it easier for operators to stop and start a single SDM z/OS Global Mirror remote copy session.

32.1.6 GDPS/GM (Global Mirror) overview

GDPS/GM is similar in some respects to GDPS/XRC in that it supports distances over 100 km. However, due to the differing characteristics of the underlying remote copy technology (Global Mirror), GDPS/GM extends the remote copy support to FB data.

GDPS/GM could be viewed somewhat as a mixture of GDPS/PPRC and GDPS/XRC. Just as GDPS/PPRC is a disk subsystem-based remote copy technology, GDPS/GM is also disk-based, meaning that it supports the same mix of CKD and FB data that is supported by GDPS/PPRC. Also, being disk-based, there is no requirement for a System Data Mover (SDM) system to drive the remote copy process. And, like Metro Mirror, Global Mirror requires that the primary and secondary disk subsystems are from the same vendor; however, Global Mirror is currently only supported by IBM disk subsystems.

On the other hand, GDPS/GM resembles GDPS/XRC in that it supports virtually unlimited distances between the application and recovery sites. Also, GDPS/GM does not provide any automation or management of the production systems—its focus is on managing the Global Mirror remote copy environment and automating and managing recovery of data and systems in case of a disaster. Also, like GDPS/XRC, GDPS/GM supports the ability to remote copy data from multiple sysplexes, whereas each GDPS/PPRC licence supports remote copy for just a single sysplex.

In addition to its disaster recovery capabilities, GDPS/GM also provides a more user-friendly interface for monitoring and managing the remote copy configuration. This includes the initialization and monitoring of the GM volume pairs based upon policy, and performing routine operations on installed storage subsystems.

More details on GDPS/GM can be found in *GDPS Family - An Introduction to Concepts and Capabilities*, SG24-6374-01.

32.1.7 GDPS 3-site solution overview

GPDS also supports 3-site configuration solutions by using a combination of the previous GDPS solutions. A 3-site solution can combine the advantages of metropolitan distance Business Continuity and regional or long distance Disaster Recovery.

GDPS PPRC/XRC

GDPS/PPRC and GDPS/XRC is a supported configuration for the 3-site requirements, as shown in Figure 32-3.

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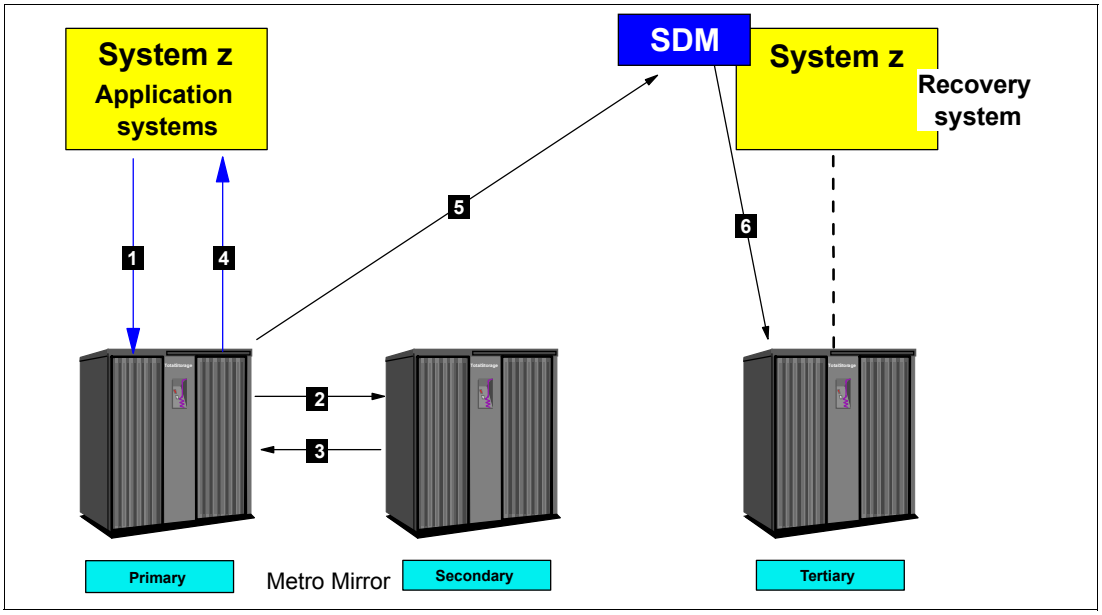

Figure 32-3 GDPS 3-site configuration with GDPS/PPRC and GDPS/XRC

The same primary volume for PPRC and XRC can be supported by two different GDPSs, a GDPS/PPRC for metropolitan distance and Business Continuity, and a GDPS/XRC for regional distance and Disaster Recovery.

The two mirroring technologies and GDPS implementations work independently of each other, yet provide the synergy of a common management scheme and common skills.

More details on GDPS 3-site configurations can be obtained from your IBM GDPS representative.

Note: GDPS/XRC supports System z data for z/OS, LINUX on z/VM, z/VM, and z/VSE. GDPS/XRC and GDPS/PPRC off of the same volume is a System z solution only.

32.1.8 IBM Global Services offerings for GDPS

The various GDPS offerings are not products. They are delivered as IBM Global Service offerings. GDPS is an end-to-end solution in which IBM Global Services tailors and installs the specific combination of components, integrated within the client's environment. GDPS integration work, including education, is done using IBM Global Services, in addition to the planning and installation of the code. This ensures that the GDPS solution provides the intended value to all parts of the business and IT processes.

The following GDPS services and offerings are provided by IBM Global Services (IGS).

GDPS technical consulting workshop (TCW)

TCW is a 2-day workshop where IGS specialists work with your representatives to understand your business objectives, service requirements, technological directions, business applications, recovery processes, cross-site, and I/O requirements. High-level education on GDPS is provided along with the service and implementation process. Various remote and local data protection options are evaluated.

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IGS specialists present a number of planned and unplanned GDPS reconfiguration scenarios with recommendations on how GDPS can assist you in achieving your objectives. At the conclusion of the workshop the following items are developed: acceptance criteria for both the test and production phases, a high-level task list, a services list, and project summary.

Remote Copy Management Facility (RCMF)

With this service, the RCMF/PPRC or RCMF/XRC automation to manage the remote copy infrastructure will be installed, the automation policy customized, and the automation verified along with providing operational education for the enterprise.

GDPS/PPRC HyperSwap Manager

IBM Implementation Services for GDPS/PPRC HyperSwap Manager helps simplify implementation by working with you to get GDPS/PPRC HyperSwap Manager and its prerequisites up and running with limited disruption to your business. On-site planning, configuration, implementation, testing, and education will help make your new IBM Implementation Services for GDPS/PPRC HyperSwap Manager solution accessible in the most efficient manner.

GDPS/PPRC and GDPS/XRC

IBM Implementation Services for GDPS/PPRC or GDPS/XRC will assist you with planning, configuration, automation code customization, testing, onsite implementation assistance, and training in the IBM GDPS solution. Either option supports Peer-to-Peer Virtual Tape Server (PtP VTS) form of tape data mirroring.

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A

Concurrent Copy

In this appendix we describe the Concurrent Copy function on the DS6000 series.

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Concurrent Copy

This appendix describes the characteristics and operation of Concurrent Copy. We also discuss the considerations involved when planning to use Concurrent Copy.

The information presented in this chapter can be complemented with the following publications:

- *z/OS DFSMS Advanced Copy Services*, SC35-0428
- *z/OS DFSMSdss Storage Administration Reference*, SC35-0424
- *z/OS V1R3.0 DFSMS Installation Exits*, SC26-7396
- *DFSMS: Implementing System Managed Storage*, SC26-7407
- *DFSMShsm Storage Administration Guide*, SC35-0388
- *DFSMS/MVS Managing Catalogs*, SC26-4914

Overview

Concurrent Copy is a copy function that helps you keep your high data availability objectives by allowing point-in-time copies of your data *concurrent* with normal application processing. Concurrent Copy works with the IBM System Storage DS6000 and the DFSMS System Data Mover (SDM). Concurrent Copy is available for the z/OS and OS/390 operating systems, and requires software support provided in DFSMS/MVS™.

Concurrent Copy works not only on a full-volume basis, but also at a data set level. Also, the target is not restricted only to DASD volumes in the same DS6000, but the target can also be a tape cartridge or a DASD volume on another DS6000 (see Figure A-1).

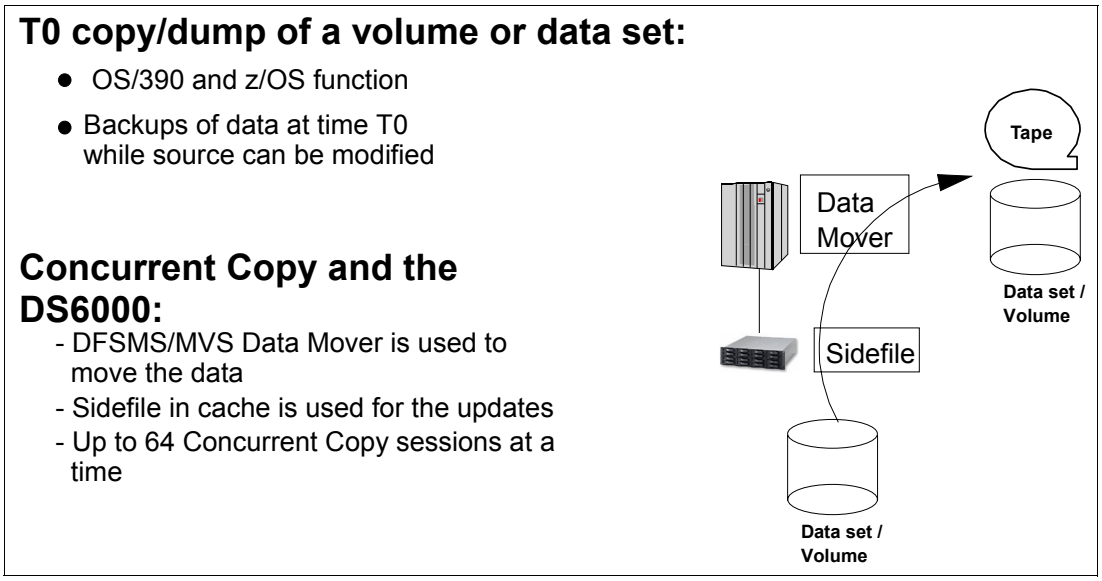
T0 copy/dump of a volume or data set:
OS/390 and z/OS function
Backups of data at time T0 while source can be modified
Concurrent Copy and the DS6000:
- DFSMS/MVS Data Mover is used to move the data
- Sidefile in cache is used for the updates
- Up to 64 Concurrent Copy sessions at a time
Tape
Data Mover
Data set / Volume
Sidefile
Data set / Volume

Figure A-1 Concurrent Copy characteristics

Concurrent Copy terminology

This section lists the definitions of the terms used with Concurrent Copy. These terms are discussed in detail in the following sections.

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Session

A session is a logical concept that represents a single invocation of Concurrent Copy (a single DFSMSdss DUMP/COPY command). A session can include one or more data sets or volumes on the same DS6000 or across different DS6000s. An individual DS6000 can support up to 16 simultaneous Concurrent Copy sessions per volume, with a maximum of 64 simultaneous sessions per LSS.

Session ID

The system assigns a unique session ID to each Concurrent Copy session. The system uses the session ID to identify and coordinate all host and DS6000 resources associated with a particular Concurrent Copy session.

Concurrent Copy domain

The set of devices and tracks identified during the initialization of a Concurrent Copy session is called the Concurrent Copy domain. It represents the set of data that Concurrent Copy copies.

Intercepted writes

When an application tries to update information that is included in a Concurrent Copy domain, the DS6000 intercepts those writes, thus maintaining a copy of the data as it was at the time when the Concurrent Copy was requested.

Sidefile

A sidefile is a temporary repository for Concurrent Copy domain tracks that still have not been copied by the SDM and are about to receive an update. During the processing of an intercepted write, the DS6000 copies a before-image of the track being updated into a sidefile for later processing. Together, the DS6000 and the SDM maintain two sidefiles, one in the DS6000 cache and another in processor storage.

Terminate

The Concurrent Copy terminates when DFSMSdss has copied the Concurrent Copy domain and both the sidefiles are empty. In error situations, either the DS6000 or the SDM can terminate the Concurrent Copy session before the entire domain has been copied.

Fuzzy copy

Without a tool like Concurrent Copy, if you make a copy of the data while the data is being updated, then the copy does not reflect a point-in-time version of the original data. In this case, the copy is fuzzy, because it does not represent any particular point-in-time status. A fuzzy copy is a set of data with no logical consistency from the application perspective.

Consistent copy

A consistent copy is a set of data with logical consistency from the application perspective. The logical consistency of the source data is guaranteed by the application itself. The logical consistency of the copied data must be ensured by a mechanism like Concurrent Copy. With the application taking care at all times that the original data is consistent, you are then able with Concurrent Copy to produce a point-in-time copy of the complete set of data. The copy will hold the same logical consistency status as the original data at that certain point-in-time.

Benefits of using Concurrent Copy

Concurrent Copy can dramatically reduce the amount of time that is required to back up your application data, hence increasing the application's availability time. When you use

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Concurrent Copy, application processing is interrupted for only a minimum time while the system initializes the Concurrent Copy session. Once Concurrent Copy is active, your applications continue to process the data, while it is being backed up using Concurrent Copy.

Concurrent Copy provides point-in-time data consistency. The system serializes access to the data being dumped or copied just long enough for the Concurrent Copy session to be initialized. This serialization takes a very short time to complete, and this process ensures the point-in-time copy will be consistent, while the copy is being done with your applications running.

Note: Many of the benefits of using Concurrent Copy also apply to using FlashCopy, with the added benefits of not using host resources (channel bandwidth, memory). However you will need to allow for FlashCopy space in your disk subsystems. You will need to decide which technique offers the best return for your business requirements.

Concurrent Copy operation

For details about the operation of Concurrent Copy, refer to *z/OS DFSMS Advanced Copy Services*, SC35-0428.

Invoking Concurrent Copy

Concurrent Copy (CC) can be invoked by either the DFSMSdss or the DFSMShsm™ functions. IMS™, CICS®, DFSMSrmm™, and DB2 can use CC for their backups.

DFSMSdss has the option of using Concurrent Copy when data sets are copied or dumped. To invoke Concurrent Copy, the CONCURRENT keyword must be specified on a DFSMSdss COPY or DUMP commands.

With DFSMShsm, system-managed data can be backed up automatically with Concurrent Copy by use of management class parameters. DFSMShsm also allows Concurrent Copy to be used when copying data using Aggregate Backup and Recovery Support (ABARS).

Using the CONCURRENT control statement of the DB2 COPY utility, you can invoke Concurrent Copy to make a full image copy. During recovery, DB2 can automatically use the most recent image copy and then apply records from the log.

Concurrent Copy requires the software support provided in DFSMS/MVS. For details on using Concurrent Copy with these products, refer to the appropriate product manual.

Concurrent Copy on the DS6000

Concurrent Copy is initiated using the CONCURRENT keyword in DFSMSdss or in applications that internally call DFSMSdss as the copy program, such as the DB2 COPY utility.

The SDM establishes a Concurrent Copy session with the DS6000. There can be up to 64 sessions active at a time per DS6000 logical subsystem (LSS).

Concurrent Copy and FlashCopy

Concurrent Copy and FlashCopy can coexist in the same DS6000.

If DFSMSdss is instructed to do a Concurrent Copy by specifying the CONCurrent (CC) keyword, and the copy is for a full volume (DFSMSdss COPY FULL command), the following will be honored based on whether FlashCopy is installed:

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With the target within the same logical subsystem or DS6000 as the source and FlashCopy installed, DFSMSdss will start a FlashCopy copy process instead of Concurrent Copy.

So, you get a FlashCopy invocation with a DFSMSdss COPY FULL command even if the CONCurrent (or CC) parameter is coded in the command.

The FASTREPLICATION parameter of the COPY command does not affect Concurrent Copy; it only applies for FlashCopy and SnapShot invocation. FASTREPLICATION(REQuired) and CONCURRENT cannot be used together in the same COPY command.

Sizing and requirements

Concurrent Copy requirements and information about sizing the storage requirements can be found in manual *z/OS DFSMS Advanced Copy Services*, SC35-0428.

Central and expanded storage

Running many Concurrent Copy jobs simultaneously can cause auxiliary (AUX) storage shortages. PTF OW50284 introduced methods to limit the amount of auxiliary storage used and will appropriately either terminate existing CC jobs, or will fail to copy data sets using Concurrent Copy. SDM provides the ability to modify the Concurrent Copy AUX values that are used in evaluating the AUX storage that is used by Concurrent Copy.

Example A-1 shows the system command for modifying the Concurrent Copy AUX delta to determine at what percentage value new Concurrent Copy data sets will not be copied using Concurrent Copy. SDM subtracts this delta value from the lower MVS percentage. The newly computed SDM percentage is then compared to the total current system AUX storage percentage being used. The default value is -1, indicating that SDM will not perform a percentage check for AUX storage usage by Concurrent Copy. The nnnn value may be any non-negative value (including zero).

Example: A-1 Modifying auxiliary storage delta for new Concurrent Copy data set

```
F ANTMAIN,P .CMTUN+3A X'FFFF' X'nnnn'
```

Example A-2 shows the system command for modifying the Concurrent Copy AUX delta to determine at what percentage value existing Concurrent Copy data sets will be terminated. SDM subtracts this delta value from the upper MVS percentage. The newly computed SDM percentage is then compared to the total current system AUX storage percentage being used. The default value is -1, indicating that SDM will not perform a percentage check for AUX storage usage by Concurrent Copy. The nnnn value can be any non-negative value (including zero).

Example: A-2 Modifying auxiliary storage delta for existing Concurrent Copy data set

```
F ANTMAIN,P .CMTUN+3C X'FFFF' X'nnnn'
```

Production and performance considerations

When planning to use Concurrent Copy, you will be paying attention to system performance considerations such as:

- Application response time
- Storage subsystem utilization
- System throughput

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- Concurrent Copy throughput

Your workload flow and your hardware configuration determines how these factors affect your ability to use Concurrent Copy.

When planning for the production use of Concurrent Copy, you should also address:

- When to schedule Concurrent Copy operations
- Where to use Concurrent Copy
- Number of simultaneous sessions (z/OS Global Mirror and Concurrent Copy) that you can run

Let us look at these considerations in more detail.

When to schedule Concurrent Copy

Many factors influence when you can schedule Concurrent Copy operations. For example, the structure of your overnight batch processing determines at what stages in the processing you can use Concurrent Copy. Similarly, factors such as availability of tape drives could restrict the intervals during which running a Concurrent Copy operation is feasible.

If other considerations are not a factor, you can use Concurrent Copy at times of lowest activity, especially lowest update activity. It might, however, be beneficial to use Concurrent Copy to back up data even during periods of higher I/O activity. In some cases, ensuring data availability may be more important than preserving levels of application performance.

Where to use Concurrent Copy

You can use Concurrent Copy to back up any data that can be backed up using DFSMSdss because DFSMSdss is the external interface to Concurrent Copy. The general-purpose design of Concurrent Copy simplifies the use of Concurrent Copy, because it builds on existing experience with DFSMSdss.

For example, IMS databases can be backed up using DFSMSdss. During the recovery process, IMS database recovery control (DBRC) coordinates recovery of the DFSMSdss dump and the application of updates from the IMS log. The same is available also for DB2. Data sets that are consistently in use, such as DFSMShsm control data sets, databases, and libraries, require specialized facilities to ensure that data set backups are nondisruptive and preserve data set integrity.

Management class attributes let you choose how DFSMShsm and DFSMSdss should process data sets that are in use during availability management. Point-in-time capabilities using Concurrent Copy on the ESS allow you to:

- Use DFSMSdss to create a point of consistency backup of CICS, IMS, or DB2 databases without needing to quiesce them during the entire backup process.
- Use DFSMSdss to create backups of data sets without requiring serialization during the entire backup process. DFSMSdss serializes the data during the Concurrent Copy initialization period (the time between the start of DFSMSdss and the issuing of the ADR734I message).
- Create and maintain multiple backup versions of DFSMShsm control data sets, while increasing the availability of DFSMShsm functions, such as recall.
- Use the backup-while-open capability for CICS VSAM data sets with DFSMSdss in batch mode or with automated DFSMShsm, to provide backups with data integrity even when the data sets are being updated. Data integrity is assured for VSAM KSDSs even when CICS access results in control interval or control area splits, or data set obtaining another extent.

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Concurrent Copy coexistence with z/OS Global Mirror

The DS6000 is not supported as a source for z/OS Global Mirror, and so there should be no concerns with coexistence.

Simultaneous Concurrent Copy sessions

As said before, each Concurrent Copy session generates additional channel load and increases utilization of the storage paths within the DS6000. If you are running multiple simultaneous Concurrent Copy sessions, it you could generate contention for these resources, resulting in greater than normal queuing and extended response times.

Number of data mover-allowed sessions

In addition to the server and storage resources needed for running multiple SDM sessions, you must consider the following design maximums:

- 16 data mover sessions per device (combined total of Concurrent Copy and/or z/OS Global Mirror)
- 64 data mover sessions per DS6000 logical subsystem (combined total of Concurrent Copy and/or z/OS Global Mirror)
- 2048 data mover sessions per DS6000 (2 Address Groups times 16 LSSs times 64)

If you attempt to use more than 16 data mover sessions per device, or more than 2048 data mover sessions per DS6000 at the same time, you receive an error message, and the copy continues using the traditional DFSMSdss copy.

Sessions for aggregate group

If you relate Concurrent Copy processing to the ABACKUP command for an aggregate group that includes numerous data sets that are on multiple devices and LSSs, a separate Concurrent Copy session is created for each LSS that has volumes containing data defined by the aggregate.

SMF information

The SDM writes a system management facility (SMF) type 42 subtype 4 record that contains session statistics for each Concurrent Copy session when the session ends. Concurrent Copy records contain the identifier CC. Among other things, you can use the information in this record to determine the following statistics:

- Session initialization time
- Maximum size of host cached storage subsystem sidefiles
- Number of intercepted writes

The SMF type 42 subtype 4 record is described in detail in *z/OS DFSMS Advanced Copy Services*, SC35-0428.

Examples of Concurrent Copy invocation

This section illustrates some examples of how Concurrent Copy can be invoked for either:

- Full volume dump
- Logical data set dump
- Logical data set copy
- Full volume copy invoking FlashCopy

We also discuss the invocation of Concurrent Copy from an application program.

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DFSMSdss: Dump and copy examples

Example A-3 shows a DFSMSdss full volume dump using Concurrent Copy. No special action is required to perform a restore operation afterwards.

Example: A-3 DFSMSdss full volume dump with Concurrent Copy

```
//DSSJOB JOB ...
//DUMPSTEP EXEC PGM=ADRDSSU
//SYSPRINT DD    SYSOUT=*
//DASD     DD    UNIT=SYSDA,VOL=SER=(SSDASD),DISP=OLD
//TAPE     DD    UNIT=TAPE,VOL=SER=(TAPE01,TAPE02,TAPE03),LABEL=(1,SL),
//  DISP=(NEW,KEEP),DSN=USER.BACKUP
//SYSIN    DD    *
       DUMP FULL INDDNAME(DASD) OUTDDNAME(TAPE) -
                  COMPRESS CONCURRENT
/*
```

Example A-4 shows a DFSMSdss logical data set dump of three fully qualified data sets using Concurrent Copy. No special action is required to perform a restore operation after a Concurrent Copy dump operation.

Example: A-4 Logical data set dump operation with CONCURRENT

```
//JOB6     JOB ...
//DUMPSTEP EXEC PGM=ADRDSSU
//SYSPRINT DD    SYSOUT=*
//TAPE     DD    UNIT=TAPE,VOL=SER=(TAPE01,TAPE02,TAPE03),LABEL=(1,SL),
//  DISP=(NEW,KEEP),DSN=USER.BACKUP
//SYSIN    DD    *
       DUMP DATASET(INCLUDE(USER.LOG,USER.TABLE,USER.XREF)) -
            OUTDDNAME(TAPE) OPTIMIZE(4) CONCURRENT
/*
```

Example A-5 shows a DFSMSdss logical data set copy using Concurrent Copy.

Example: A-5 Data set Copy with CONCURRENT

```
//DSSJOB JOB ...
//COPYSTEP EXEC PGM=ADRDSSU
//SYSPRINT DD   SYSOUT=*
//SYSIN    DD   *
       COPY DATASET(INCLUDE(USER.LOG,USER.TABLE,USER.XREF)) -
            OUTDYNAM(OVOL01,OVOL02,OVOL03,OVOL08) -
            ALLDATA(*) ALLEXCP CONCURRENT -
            STORCLAS(BACKUP) RENAMEUNCONDITIONAL(USERX)
/*
```

DFSMSdss: FlashCopy example

Example A-6 shows an example of the use of FlashCopy and Concurrent Copy together. It is a full volume copy between two volumes in the same LSS. As such, they were eligible for FlashCopy, and FlashCopy was used as shown by the message ADR806I. At the same time, the CC keyword is specified so that you obtain both ADR806I and ADR734I Concurrent Copy initialization successful messages.

Example: A-6 Using FlashCopy and Concurrent Copy together

```
//STEPT40 EXEC PGM=ADRDSSU
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=V,OUTLIM=3000
```


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```
//SYSIN   DD *
//*
COPY FULL -
   INDYNAM ((CP11S3)) -
     OUTDYNAM ((TP11S3)) -
   COPYVOLID -
     CC
ADR101I (R/I)-RI01 (01), TASKID 001 HAS BEEN ASSIGNED TO COMMAND 'COPY '
ADR109I (R/I)-RI01 (01), 2000.107 16:09:59 INITIAL SCAN OF USER CONTROL STATEMENTS
COMPLETED.
ADR016I (001)-RI01 (01), RACF LOGGING OPTION IN EFFECT FOR THIS TASK
ADR006I (001)-STEND(01), 2000.107 16:10:00 EXECUTION BEGINS
ADR241I (001)-DDTFP(01), TARGET VTOC BEGINNING AT 000550:0000 AND ENDING AT 000550:0014 IS
OVERLAID
ADR806I (001)-TOMI (02), VOLUME COPIED USING A FAST REPLICATION FUNCTION.
ADR734I (001)-TOMI (03), 2000.107 16:10:12 CONCURRENT COPY INITIALIZATION SUCCESSFUL FOR
VOLUME CP11S3. SERIALIZATION FOR THIS DATA
                         IS RELEASED IF DFSMSDSS HELD IT. THE INTERMEDIATE RETURN CODE IS
0000.
ADR320I (001)-SBRTN(01), VOLUME SERIAL TP11S3 ON UNIT D70C IS CHANGED TO CP11S3
ADR344I (001)-SBRTN(01), VOLSER ON UCB D70C IS A DUPLICATE. VOLUME MADE UNAVAILABLE.
ADR006I (001)-STEND(02), 2000.107 16:10:35 EXECUTION ENDS
ADR013I (001)-CLTSK(01), 2000.107 16:10:35 TASK COMPLETED WITH RETURN CODE 0000
ADR012I (SCH)-DSSU (01), 2000.107 16:10:35 DFSMSDSS PROCESSING COMPLETE. HIGHEST RETURN
CODE IS 0000
```

Invocation from an application program

When DFSMSdss is invoked from an application program, you can use the user interaction module (UIM) to interact with DFSMSdss. For user interactions to take place, the application must invoke DFSMSdss and must provide a pointer to a user interaction module (UIM) list. DFSMSdss can be invoked by any of the following system macros:

```
ATTACH EP=ADRDSSU,PARAM=(OPTPTR,DDPTR,PAGEPTR,UIMPTR,UAPTR),VL=1
LINK EP=ADRDSSU,PARAM=(OPTPTR,DDPTR,PAGEPTR,UIMPTR,UAPTR),VL=1
CALL (15),(OPTPTR,DDPTR,PAGEPTR,UIMPTR,UAPTR),VL
```

When a UIM exit routine is specified, DFSMSdss processes normally, then at each point in the process (DFSMSdss exit points), the UIM exit routine is called conditionally to allow some types of user operations. The exit identification block is passed to the UIM every time DFSMSdss gives control to it.

Among the exit points that are available with DFSMSdss (EIOPTION 1 to 26), DFSMSdss calls the UIM with option code 24 (EIOPTION 24) to inform it that the initialization of the Concurrent Copy session for a given data set or volume has completed. For full volume or tracks operation, there is only one call (because there is only one input volume). For a physical data set operation, there is one call for each input volume. For a logical data set operation, there is one call for every data set.

DFSMSdss does not call the UIM with this option code, if the CONCURRENT keyword is not specified. DFSMSdss provides the UIM with information through the EIREC24 structure within the exit identification block, ADREIB (in the ADREID0 macro).

For a detailed description of the DFSMSdss interaction with the user interface module (UIM) when invoking from an application program, refer to *z/OS DFSMSdss Storage Administration Reference*, SC35-0424.

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Installation options exit

Usage of the Concurrent Copy function can also be controlled through the installation options exit, a product-sensitive programming interface intended for users. Refer to Options Installation Exit Routine (ADRUIXIT) described in *z/OS DFSMS Installation Exits*, SC26-7396, for more information.

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B

SNMP notifications

This appendix describes SNMP traps that are sent out in a Remote Copy environment. It repeats some of the SNMP trap information that is available in *IBM System Storage DS6000 Series: Architecture and Implementation*, SG24-6781.

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SNMP overview

The DS8000 sends out SNMP traps when a state change in a remote copy services environment occurs. Therefore, 13 traps are implemented. The traps 1xx are sent out for a state change of a physical link connection, and the 2xx traps are sent out for state changes in the logical copy services setup.

The DS HMC can be set up to send SNMP traps to up to 2 defined IP addresses. *eRCMF* (see Chapter 30, “IIBM TotalStorage Rapid Data Recovery” on page 457*)* is listening to SNMP traps for the DS6000. Also, a Network Management program, such as Tivoli Netview, can be used to catch and process the SNMP traps.

Physical connection events

With the trap 1xx range, a state change of the physical links is reported. The trap is sent out if the physical remote copy link is interrupted. The link trap is sent from the primary system. The *PLink* and *SLink* columns are only used by the Enterprise Storage Server (ESS).

If one or several links (but not all links) are interrupted, a trap 100, as shown in Example B-1, is posted; it indicates that the redundancy is degraded. The `RC` column in the trap represents the reason code for the interruption of the link. The reason codes are listed in Table B-1 on page 521.

Example: B-1 Trap 100: PPRC links degraded

```
PPRC Links Degraded
UNIT: Mnf Type-Mod SerialNm LS
PRI:  IBM 1750-511 13-00247 18
SEC:  IBM 1750-511 13-00819 18
Path: Type  PP   PLink  SP   SLink  RC
1:    FIBRE 0003 XXXXXX 0003 XXXXXX OK
2:    FIBRE 0103 XXXXXX 0002 XXXXXX 17
```

If all links are interrupted, a trap 101, as shown in Example B-2, is posted. This event indicates that communication between primary and secondary system is no longer possible.

Example: B-2 Trap 101: PPRC links down

```
PPRC Links Down
UNIT: Mnf Type-Mod SerialNm LS
PRI:  IBM 1750-511 13-00247 18
SEC:  IBM 1750-511 13-00819 18
Path: Type  PP   PLink  SP   SLink  RC
1:    FIBRE 0003 XXXXXX 0003 XXXXXX 17
2:    FIBRE 0103 XXXXXX 0002 XXXXXX 17
```

When the DS6000 can communicate again by any of the links, trap 102, as shown in Example B-3, is sent after one or more of the interrupted links are available again.

Example: B-3 Trap 102: PPRC links up

```
PPRC Links Up
UNIT: Mnf Type-Mod SerialNm LS
PRI:  IBM 1750-511 13-00247 18
SEC:  IBM 1750-511 13-00819 18
Path: Type  PP   PLink  SP   SLink  RC
```


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```
1:    FIBRE 0003 XXXXXX 0003 XXXXXX OK
2:    FIBRE 0103 XXXXXX 0002 XXXXXX OK
```

Table B-1 PPRC path reason codes

Reason Code	Description
00	No path.
01	ESCON path established.
02	Initialization failed. ESCON link reject threshold exceeded when attempting to send ELP or RID frames.
03	Time out. No reason available.
04	No resources available at primary for the logical path establishment.
05	No resources available at secondary for the logical path establishment.
06	Secondary CU Sequence Number or Logical Sub- system number mismatch.
07	Secondary CU SS ID mismatch or failure of the I/O that collects secondary information for validation.
08	ESCON link is offline. This is caused the lack of light detection coming from a host, peer or switch.
09	Establish failed but will retry when conditions change.
0A	The primary control unit port or link cannot be converted to channel mode since a logical path is already established on the port or link. The establish paths operation will not be retried within the control unit automatically.
0B	Reserved for use by StorageTek™.
10	Configuration Error. The source of the error is one of the following: 1. The specification of the SA ID does not match the installed ESCON adapter cards in the primary controller. 2. For ESCON paths, the secondary control unit destination address is zero and an ESCON Director (switch) was found in the path. 3. For ESCON paths, the secondary control unit destination address is non-zero and an ESCON Director does not exist in the path. That is, the path is a direct connection.
11	Reserved.
12	Reserved.
13 / OK	Fibre path established.
14	Fibre Channel Path Link Down.
15	Fibre Channel Path Retry Exceeded.
16	Fibre Channel Path Secondary Adapter not PPRC capable. This could be due to: 1. Secondary Adapter not configured properly, or does not have the correct microcode loaded. 2. The secondary adapter is already a target of 32 different ESS, DS8000, DS6000.
17	Fibre Channel Path Secondary Adapter not available.
18	Fibre Channel Path Primary Login Exceeded.
19	Fibre Channel Path Secondary Login Exceeded.

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Remote copy events

If you have configured Consistency Groups and a volume in this Consistency Group is suspended because of a write error to the secondary device, trap 200, as shown in Example B-4, is sent. One trap is sent for each LSS that is configured with the Consistency Group option. This trap could be handled by automation software like *eRCMF* to freeze this Consistency Group.

Example: B-4 Trap 200: LSS-pair Consistency Group PPRC-pair error

```
LSS-Pair Consistency Group PPRC-Pair Error
UNIT: Mnf Type-Mod SerialNm LS LD SR
PRI:  IBM 1750-511 13-00247 18 00 07
SEC:  IBM 1750-511 13-00819 18 00
```

Trap 202, as shown in Example B-5, is sent if a remote Copy Pair goes into a suspend state. The trap contains the serial number (*SerialNm) of* the primary and secondary machine, the LSS (*LS*) and the logical device (*LD*). To avoid SNMP trap flooding, the number of SNMP traps for the LSS is throttled. The complete suspended pair information is represented in the summary. The last row of the trap represents the suspend state for all pairs in the reporting LSS. The suspended pair information contains a hexadecimal string of 64 characters. By converting this hex string into binary, each bit represents a single device. If the bit is 1, then the device is suspended; otherwise, the device is still in full duplex mode.

Example: B-5 Trap 202: Primary PPRC devices on LSS suspended due to error

```
Primary PPRC Devices on LSS Suspended Due to Error
UNIT: Mnf Type-Mod SerialNm LS LD SR
PRI:  IBM 1750-511 13-00247 18 00 07
SEC:  IBM 1750-511 13-00819 18 00
Start: 2005/11/15 19:04:10 GMT
PRI Dev Flags (1 bit/Dev, 1=Suspended):
8000000000000000000000000000000000000000000000000000000000000000
```

Global Mirror related events

Trap 210, as shown in Example B-6, is sent when a Consistency Group in a Global Mirror environment is successfully formed.

Example: B-6 Trap210: Asynchronous PPRC initial Consistency Group successfully formed

```
Asynchronous PPRC Initial Consistency Group Successfully Formed
UNIT: Mnf Type-Mod SerialNm
      IBM 1750-511 13-00247
Session ID: 4001
```

Trap 211, as shown in Example B-7 is sent out if the Global Mirror setup is in a severe error state, where no attempts to form a Consistency Group can be performed.

Example: B-7 Trap 211: Asynchronous PPRC Session is in a fatal state

```
Asynchronous PPRC Session is in a Fatal State
UNIT: Mnf Type-Mod SerialNm
      IBM 1750-511 13-00247
Session ID: 4002
```


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Trap 212, as shown in Example B-8, is sent when a Consistency Group cannot be created in a Global Mirror Copy relation. Some of the reasons could be:

- Volumes have been taken out of a copy session.
- The remote copy link bandwidth might not be sufficient.
- The FC link between the PPRC primary and secondary system are not available.

Example: B-8 Trap 212: Asynchronous PPRC Consistency Group failure - retry will be attempted

```
Asynchronous PPRC Consistency Group Failure - Retry will be attempted
UNIT: Mnf Type-Mod SerialNm
      IBM 1750-511 13-00247
Session ID: 4001
```

Trap 213, as shown in Example B-9, is sent when a Consistency Group in a Global Mirror environment could be formed after a previous Consistency Group formation failure.

Example: B-9 Trap 213: Asynchronous PPRC Consistency Group successful recovery

```
Asynchronous PPRC Consistency Group Successful Recovery
UNIT: Mnf Type-Mod SerialNm
      IBM 1750-511 13-00247
Session ID: 4001
```

Trap 214, as shown in Example B-10, is sent out if a Global Mirror Copy Session is terminated using the DS CLI command **rmgmir** or the corresponding GUI function.

Example: B-10 Trap 214: Asynchronous PPRC Master terminated

```
Asynchronous PPRC Master Terminated
UNIT: Mnf Type-Mod SerialNm
      IBM 1750-511 13-00247
Session ID: 4001
```

Trap 215, as shown in Example B-11, is sent if in the Global Mirror Environment the Master has detected a failure to complete the FlashCopy commit. The trap is sent after a number of commit retries have failed.

Example: B-11 Trap 215: Asynchronous PPRC FlashCopy at remote site unsuccessful

```
Asynchronous PPRC FlashCopy at Remote Site Unsuccessful
UNIT: Mnf Type-Mod SerialNm
      IBM 1750-511 13-00819
Session ID: 4001
```

Trap 216, as shown in Example B-12, is sent if a Global Mirror *Master* cannot terminate the Global Copy relationship at one of its *Subordinates* (*slave*). This might occur if the Master is terminated with **rmgmir** but the Master cannot terminate the copy relationship on the Subordinate. Consider running a **rmgmir** against the Subordinate to prevent any interference with other Global Mirror sessions.

Example: B-12 Trap 216: Asynchronous PPRC Subordinate termination unsuccessful

```
Asynchronous PPRC Slave Termination Unsuccessful
UNIT:   Mnf Type-Mod SerialNm
Master: IBM 1750-511 13-00247
Slave:  IBM 1750-511 13-00260
Session ID: 4002
```


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Trap 217, as shown in Example B-13, is sent if a Global Mirror Copy Environment was suspended by the DS CLI command **pausegmir** or the corresponding GUI function.

Example: B-13 Trap 217: Asynchronous PPRC paused

```
Asynchronous PPRC Paused
UNIT: Mnf Type-Mod SerialNm
      IBM 1750-511 13-00247
Session ID: 4001
```


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C

Licensing

In this appendix we describe how the licensing functions for Copy Services for the DS6000 Series are arranged.

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Licenses

All DS6000 Series machines must have an Operating Environment License or OEL for the total storage installed, as calculated in decimal TB. Licenses are also required for use of Copy Services functions.

Each function is enabled for a DS6000 system by acquiring licences for specific feature numbers, as listed in Table C-1.

Table C-1 DS6000 licensed functions

Licensed Function	Feature Number
Operating Environment	50xx
Parallel Access Volumes	51xx
Point-in-Time Copy (FlashCopy)	52xx
Remote Mirror and Copy (Metro Mirror, Global Mirror, Global Copy)	53xx
FICON Attachment	59xx

Following are the DS6000 Licensed Function feature numbers:

- **OEL:** Operating Environment License
  - OEL - 1 TB 5010
  - OEL - 5 TB 5011
  - OEL - 10 TB 5012
  - OEL - 25 TB 5013
  - OEL - 50 TB 5014
- **FICON:** z/OS attachment
  - FICON Attachment 5920
- **PAV:** Parallel Access Volumes
  - PAV - 1 TB 5110
  - PAV - 5 TB 5111
  - PAV - 10 TB 5112
  - PAV - 25 TB 5113
  - PAV - 50 TB 5114

The following licenses apply to Copy Services:

- **PTC:** Point-in-Time Copy, also known as FlashCopy
  - PTC - 1 TB 5210
  - PTC - 5 TB 5211
  - PTC - 10 TB 5212
  - PTC - 25 TB 5213
  - PTC - 50 TB 5214
- **RMC:** Remote Mirror and Copy Licenses:
  - RMC - 1 TB 5310
  - RMC - 5 TB 5311
  - RMC - 10 TB 5312
  - RMC - 25 TB 5313
  - RMC - 50 TB 5314

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It should be noted that the RMC License provides the functions of Metro Mirror, Global Copy, and Global Mirror, depending on how it is configured during installation. These functions were previously known as PPRC and its variants. Note also that, for the DS6000 and ESS, the previous Extended Remote Copy (XRC) copy service is now known as Remote Mirror and Copy for z/OS, or RMZ. You cannot order an RMZ license for DS6000.

Authorized level

All Copy Services functions require licensing to be activated. This means that you must have purchased a license for the appropriate level of storage for each Copy Service function that is required. You then must install the License Key that is generated using the Disk Storage Feature Activation application (*DSFA)*. Another consideration relates to the authorized level required. In most cases, the total capacity installed must be licensed. This is the total capacity in decimal TB equal to or greater than the actual capacity installed, including all RAID parity disks and hot spares.

An exception can be where a mix of both System z and open systems hosts are using the same storage server. In this case, it is possible to acquire Copy Services licenses for just the capacity formatted for CKD, or just the capacity formatted for FB storage. This implies that the licensed Copy Services function is needed only for open systems hosts, or only for System z hosts. If, however, a Copy Services function is required for both CKD and FB, then that Copy Services license must match the total configured capacity of the machine. Authorization level is maintained by the licensed code in the controller and the DSFA application.

Example: Actual capacity is 15 TB, used for both CKD and FB, the scope for the OEL is therefore a type of ALL and the installed OEL must be at least 15 TB. If the client has split storage allocation, with 8 TB for CKD and only CKD storage is using FlashCopy, then the scope type for the PTC license can be set to CKD. Now the PTC license can be purchased at the CKD level of 8 TB. However, this means that no open systems hosts can use the FlashCopy function.

The actual ordered level of any Copy Service license can be any level above that required or installed. Licenses can be added and have their capacities increased, nondisruptively, to an installed system.

Important: A decrease in the scope or capacity of a license requires a disruptive power cycle for the DS6000.

Charging example

A client can choose to purchase any or all DS6000 licenses at an authorization level at or above the installed raw disk capacity. It may be more cost effective to pre-install authorization to use greater than the currently installed storage capacity.

A simple rule for charges is remembering that the required authorization level depends upon the license scope:

- If the license scope is FB, the authorization level must be equal to or greater than the total amount of physical capacity in the system that is to be logically configured as FB.
- If the license scope is CKD, the authorization level must be equal to or greater than the total amount of physical capacity in the system that is logically configured as CKD.
- If the license scope is ALL, the authorization level must be equal to or greater than the total system physical capacity.

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D

CLI migration

This appendix discusses the ways that you can migrate Copy Services tasks on the ESS environment to the DS Copy Services environment. The Copy Services functions described here cover the GUI and the CLI. Excluded are the Copy Services functions that are executed directly by z/OS.

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Migrating ESS CLI to DS CLI

With the introduction of the IBM DS6000 Storage Unit, a new Copy Services application is also introduced. The Copy Services functions can be issued with the GUI or the DS CLI.

The advanced Copy Services functions that are available in the ESS 800 are also available on the DS6000 (except for Global Mirror). Although the functions are still available, there are also some differences that need to be considered when replacing your ESS CLI with a DS CLI. These are:

- Point-in-Time Copy (FlashCopy) does not support Consistency Groups on the GUI.
- Fibre Channel is used for Metro Mirror and Global Mirror.
- The GUI runs in real time only (tasks cannot be saved), while the CLI can be invoked with a saved script.
- The DS CLI supports both the ESS 800/750 and the DS6000/DS8000.
- The ESS 800 must be at Licensed Internal Code (LIC) level 2.4.x or higher.

Reviewing the ESS tasks to migrate

Review the Copy Services tasks you want to migrate. You can perform this review from your ESS GUI or ESS CLI. In Example D-1, **esscli list** is used to display the tasks:

Example: D-1 esscli list task

```
esscli list task –s copy_services-server –u csadmin –p passw0rd

Wed Nov 24 10:29:31 EST 2004 IBM ESSCLI 2.4.0
Task Name                       Type                            Status
-------------------------------------------------------------------------
H_Epath_test16                  PPRCEstablishPaths              NotRunning
H_Epath_test17                  PPRCEstablishPaths              NotRunning
Brocade_pr_lss10                PPRCEstablishPair               NotRunning
Brocade_pr_lss11                PPRCEstablishPair               NotRunning
Flash10041005                   FCEstablish                     NotRunning
```

You can use ESS CLI to display the contents of each saved task and write the contents to a file. See Example D-2.

Example: D-2 esscli show task command

```
esscli show task –s copy_services_server –u csadmin –p passw0rd –d “name=Flash10041005”

Wed Nov 24 10:37:17 EST 2004 IBM ESSCLI 2.4.0
Taskname=Flash10041005
Tasktype=FCEstablish
Options=NoBackgroundCopy
SourceServer=2105.23953
TargetServer=2105.23953
SourceVol             TargetVol
-------------------------------------------------------------------------
1004                  1005
```

You can also check your saved tasks via the ESS GUI. See Figure D-1 on page 531.

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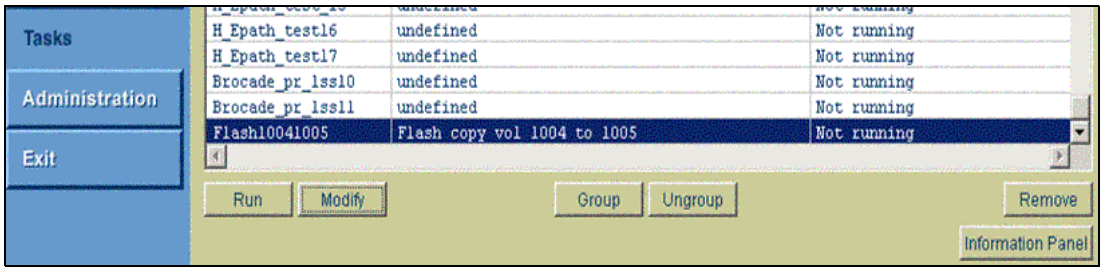

Figure D-1 ESS Copy Services GUI tasks panel

Highlight the task and click the information panel. See Figure D-2.

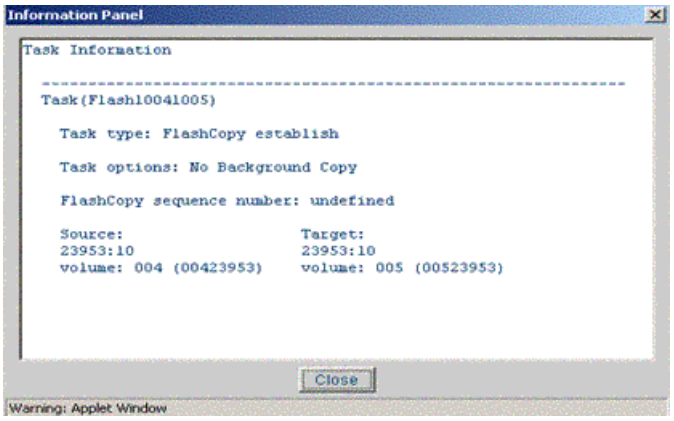

Figure D-2 ESS task information

Review also the specific server scripts (depending on the operating system), that perform tasks that set up and execute saved ESS CLI saved tasks. You might have to edit or translate these scripts to run your DS CLI scripts.

Convert the individual tasks

Choose the ESS CLI tasks that you need to translate to the DS CLI. Refer to *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922. You can then save each translated task and run it in the DS6000 CLI environment.

Note: The DS GUI (via the DS SMC) does not save Copy Services tasks such as the ESS GUI. You can only use the DS GUI for Copy Services in real time mode.

Translate also (if needed) and edit the individual server scripts that set up and execute the saved DS CLI scripts. See Table D-1 for an example of command translation.

Table D-1 Converting ESS CLI to DS CLI

Task parameter	ESS CLI parameter	DS CLI conversion	Description
Tasktype	FCEstablish	mkflash	establish FlashCopy
Options	NoBackgroundCopy	-nocp	No background copy upon FlashCopy
SourceServer	2105.23953	-dev IBM.2105-23953	device ID

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Task parameter	ESS CLI parameter	DS CLI conversion	Description
TargetServer	2105.23953	N/A	used only once in DS CLI
Source and Target vols.	1004 1005	1004:1005	separated by a colon in DS CLI

DS CLI commands

Example D-3 shows the translation to a DS CLI command.

Example: D-3 DS CLI mkflash

```
dscli> mkflash -nocp -dev IBM.2105-23953 1004:1005
CMUC00137I mkflash: FlashCopy pair 1004:1005 successfully created.
dscli> lsflash -dev IBM.2105-23953 1004:1005
ID        SrcLSS SequenceNum Timeout ActiveCopy Recoding Persistent Revertible
=============================================================================
1004:1005 10     0           120     Disabled   Disabled Disabled   Disabled
```

See Figure D-3 for the GUI output.

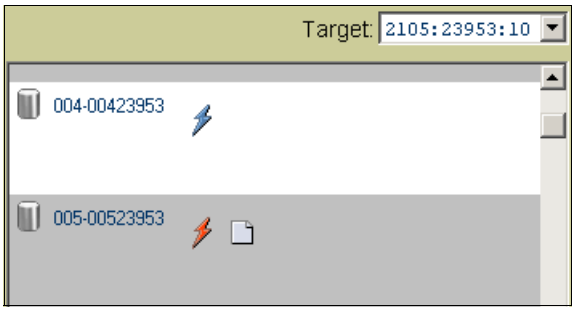

Figure D-3 ESS GUI FlashCopy window

Important: On the ESS 800, open systems volume IDs are given in an eight-digit format, xxx-sssss where xxx is the LUN ID and sssss is the serial number of the ESS 800. In the example used in this appendix, the volumes shown are 004-23953 to 005-23953. These volumes are open systems, or fixed block volumes. When referring to them in the DS CLI, you must add 1000 to the volume ID, so that volume 004-23953 is volume ID 1004 and volume 005-23953 is volume ID 1005. This is very important because on the ESS 800, the following address ranges are actually used:

0000 to 0FFF System z CKD volumes (4096 possible addresses)
1000 to 1FFF Open systems fixed block LUNs (4096 possible addresses)

If you intend to FlashCopy ESS LUN 004-23953 onto 005-23953 with the DS CLI, you must specify 1004 and 1005. If instead, you specify 0004 and 0005, you will actually run the FlashCopy against CKD volumes. This can result in an unplanned outage on the System z host that is using CKD volume 0005.

The ESS CLI command, **`show task`**, shows the correct value for the volume ID.

ESS / DS CLI comparison

Table D-2 shows a brief comparison of the major components between the ESS CLI and the DS CLI.

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Table D-2 ESS and DS CLI commands and parameters comparison

ESS CLI	DS CLI	Comments
list server	lsserver	Like the 2105, the 1750 storage facility image contains one pair of servers.
list volumespace	lsextpool, showextpool, lsrank, showrank, lsarray, showarray, lsarraysite	See Note 1
create volumespace	mkextpool, mkarray, mkrank	
delete volumespace	rmrank, rmarray, rmextpool	
list diskgroup	lsarraysite	A 1750 Array Site can consist of at least four disk drives (DDMs) that are made into a RAID Array. The 1750 does not support the JBOD Array configuration.
list port	lsioport, showioport	The 1750 CLI lsioport and showioport commands include the –metrics parameter that returns the performance counter values for the respective I/O port IDs. The –metrics parameter provides the means to monitor I/O port performance statistics.
set port	setioport	See Note 2
list volume	lsfbvol, lsckdvol	See Note 3
create volume	mkfbvol, mkckdvol	
set volume	chfbvol, chckdvol	
list pav	lsckdvol, showckdvol	
create pav	mkckdvol	
delete pav	rmckdvol	
list volumeaccess	lsvolgrp, showvolgrp	See Note 4
create volumeaccess	mkvolgrp, chvolgrp	
delete volumeaccess	rmvolgrp	
list hostconnection	lshostconnect, showhostconnect	The 1750 CLI commands include the volume group ID parameter. For 2107, the hostconnect commands concern SCSI-FCP host port connections to ESS I/O ports that are configured for SCSI-FCP and “identified” access mode.
create hostconnection	mkhostconnect	
delete hostconnection	rmhostconnect	
set hostconnection	chhostconnect	
list log	N/A	

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ESS CLI	DS CLI	Comments
list featurecode	lsda, lshba, lsioencl, lsuser, mkuser, rmuser, chuser, lsstgencl	The 1750 CLI commands can display feature codes when the appropriate parameters are used with the commands.
list task	NA	
show task	NA	
list pprcpaths	lspprcpath	Unlike the 2105, the 1750 CLI Copy Services functions are not task oriented. The 1750 CLI provides a complete set of FlashCopy and PPRC make, change, remove, list, and show commands.
rsExecuteTask	mkflash, rmflash, mkpprc, rmpprc, mkpprcpath, rmpprcpath, mksession, chsession, rmsession	The 1750 CLI provides a complete set of FlashCopy and PPRC commands that can be used in the coding of scripts that emulate 2105 Copy Services tasks.
rsList2105s	lssu	The 1750 CLI lssu command returns both 2105 and 1750 objects that are contained in the ESS Network Interface domain
rsQuery, rsQueryComplete, rsFlashCopyQuery	lsflash, lspprc	These 1750 Copy Services CLI commands are equivalent to the respective 2105 CLI commands. The 1750 mkflashcopy and mkpprc commands provide a wait flag that delays command response until copy complete status is achieved.
rsTestConnection	lsaavailpprcport	

Note 1

Volume space configuration is a primary difference between 2105 and 1750. Like the 2105, a 1750 Storage Unit volume space contains a RAID-5 or RAID-10 array and a Rank that is configured from an Array Site. For 2105, one command configures an Array Site into a RAID array and Rank. For 1750, one command configures an Array Site into an Array, and a second command configures an Array into a Rank. For 2105, a Rank is configured as fixed block or CKD. For 1750, a Rank is assigned to a user-defined Extent Pool object, which the user defines as either the fixed block or CKD storage type.

The “interleave” volume construct does not exist for 1750. For 2105, a volume is configured from a specific Rank, and cannot span Rank boundaries. For 1750, a volume is configured from an Extent Pool. An Extent Pool can contain multiple Ranks. A 1750 volume consists of one or more Extents that can be allocated from one or more Ranks. A fixed block Extent is 1 GB (using binary counting).

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For 2105, a Rank is either assigned to server 0 or server 1, depending on the Array Site location. A 2105 Rank is assigned to one of 32 possible LSS IDs, depending on device adapter pair location and storage type configuration.

For 1750, an Extent Pool is assigned to server 0 or server 1. A Rank that is configured from any Array Site can be assigned to a server 0 or 1 Extent Pool. Array Site position and device adapter pairs are not factors for the Rank-to-Extent Pool assignment. A volume that is created from a server 0 Extent Pool is assigned to an even-numbered LSS ID. A volume that is created from a server 1 Extent Pool is assigned to an odd-numbered LSS ID. A user must define at least two Extent Pools (0 and 1), but can define as many Extent Pools as there are Ranks. For 2105, a user can delete a Rank, but cannot delete a volume. For 1750, a user can delete a single volume, Rank, or Extent Pool. The 1750 CLI **showrank** and **showextpool** commands include a metrics parameter that returns the performance counter values for a specified Rank or Extent Pool ID. The metrics parameter provides the means to monitor Rank and Extent Pool performance statistics.

Note 2

A 1750 fibre-channel port is configured for either SCSI-FCP or FICON protocol. Like 2105, a FICON port is restricted to the point-to-point/switched fabric topology setting. A FICON I/O port is used for System z host attachment, but cannot be configured as a PPRC path. A FICON port must be configured for anonymous access mode, meaning that any System z host system port (WWNN/WWPN) has unrestricted access to all CKD volumes, up to 8192 volumes.

Like 2105, a 1750 fibre-channel SCSI-FCP I/O port can be configured for either the point-to-point/switched fabric or FC-AL connection topologies. A port that uses the point-to-point/switched fabric topology can be simultaneously used for OS host system I/O and for PPRC path configurations. The Fibre Channel SCSI-FCP IO port only allows “identified” host system ports to access volumes. A host system port WWPN must be identified (registered) to each 1750 IO port through which volume access is intended. Host system port WWPN identification is accomplished by the mkhostconnect CLI command.

Note 3

A 1750 Storage Unit can contain up to 8192 volumes, where either they are all FB or all CKD, or there are 4096 CKD volumes and 4096 FB volumes. A 2105 Storage Unit can contain up to 4096 FB volumes and 4096 CKD volumes. Otherwise, the 2105 and 1750 volume definitions and characteristics are essentially identical.

For 1750 CKD PAV volumes, the CLI **list** and **show** commands identify both the original base and current base volume assignments. The original and current base concept exists for 2105, but specific relationships are not identified in the output.

The 1750 CLI provides a specific set of volume commands for each storage type, fixed block or CKD, as a means to clarify input parameter and output device adapter definitions.

The 1750 CLI **showfbvol** and **showckdvol** commands include a metrics parameter that returns the performance counter values for a specified volume ID. The metrics parameter provides the means to monitor volume performance statistics.

Note 4

The 2105 volume access commands concern volume ID assignment to a SCSI-FCP host port initiator, or WWPN. For 1750, volume IDs are assigned to a user defined volume group ID (**mkvolgrp** and **chvolgrp**). A volume group ID is then assigned to one or more host system ports (**mkhostconnect** and **chhostconnect**) as a means of completing the volume access configuration.

The volume group construct also exists in the 2105 internal code, but the construct is not externalized by the 2105 Specialist or CLI commands.

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Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

IBM Redbooks

For information about ordering these publications, see “How to get IBM Redbooks” on page 539. Note that some of the documents referenced here may be available in softcopy only.

- *IBM System Storage DS6000 Series: Architecture and Implementation*, SG24-6781
- *IBM System Storage DS6000 Series: Copy Services in Open Environments*, SG24-6783
- *IBM System Storage DS6000 Series: Copy Services with System z servers*, SG24-6782
- *IBM TotalStorage Business Continuity Solutions Guide*, SG24-6547
- *The IBM TotalStorage Solutions Handbook*, SG24-5250

You might find the following redbooks related to the DS8000 and ESS useful, particularly if you are implementing a mixed systems environment with Copy Services.

- *IBM System Storage DS8000 Series: Architecture and Implementation*, SG24-6786
- *IBM System Storage DS8000 Series: Copy Services in Open Environments*, SG24-6788
- *IBM System Storage DS8000 Series: Copy Services with System z servers*, SG24-6787
- *IBM TotalStorage Enterprise Storage Server Implementing ESS Copy Services in Open Environments*, SG24-5757
- *IBM TotalStorage Enterprise Storage Server Implementing ESS Copy Services with IBM @server zSeries*, SG24-5680

Other publications

These publications are also relevant as further information sources. Note that some of the documents referenced here might be available in soft copy only.

- *IBM System Storage DS6000: Installation, Troubleshooting, and Recovery Guide,* GC26-7924
- *IBM System Storage DS6000 Introduction and Planning Guide*, GC26-7925
- *IBM System Storage DS6000: Command-Line Interface User´s Guide*, GC26-7922
- *IBM System Storage DS6000: Host Systems Attachment Guide*, GC26-7923
- *IBM System Storage Multipath Subsystem Device Driver User’s Guide*, SC30-4131
- *IBM System Storage DS Open Application Programming Interface Reference*, GC35-0516
- *IBM System Storage DS8000 Messages Reference*, GC26-7914
- *z/OS DFSMS Advanced Copy Services*, SC35-0428
- *Device Support Facilities: User’s Guide and Reference*, GC35-0033

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Online resources

These Web sites are also relevant as further information sources:

- Documentation for DS6800:

  http://www.ibm.com/servers/storage/support/disk/ds6800/
- SDD and Host Attachment scripts at:

  http://www.ibm.com/support/
- IBM Disk Storage Feature Activation (DSFA) Web site at:

  http://www.ibm.com/storage/dsfa
- The PSP information can be found at:

  http://www-1.ibm.com/servers/resourcelink/svc03100.nsf?OpenDatabase
- Documentation for the DS6000 at:

  http://www.ibm.com/servers/storage/support/disk/1750.html
- The interoperability matrix at:

  http://www.ibm.com/servers/storage/disk/ds6000/interop.html
- Fibre Channel host bus adapter firmware and driver level matrix at:

  http://knowledge.storage.ibm.com/servers/storage/support/hbasearch/interop/hbaSearch.do
- ATTO at:

  http://www.attotech.com/
- Emulex at:

  http://www.emulex.com/ts/dds.html
- JNI at:

  http://www.jni.com/OEM/oem.cfm?ID=4
- QLogic at:

  http://www.qlogic.com/support/ibm_page.html
- IBM at:

  http://www.ibm.com/storage/ibmsan/products/sanfabric.html
- McDATA at:

  http://www.mcdata.com/ibm/
- Cisco at:

  http://www.cisco.com/go/ibm/storage
- CIENA at:

  http://www.ciena.com/products/transport/shorthaul/cn2000/index.asp
- Nortel at:

  http://www.nortelnetworks.com/
- ADVA at:

  http://www.advaoptical.com/

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